SMILES, AFFORDANCES, AND SOCIAL INTERACTION

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ABSTRACT

This thesis describes a program of research designed to investigate the sensitivity of perceivers to the ontological distinctions between simulated expressions of happiness unrelated to positive emotional experience, or, *posed* smiles, and spontaneous, veridical expressions of positive affect, or, *genuine* smiles. Importantly, this research was conducted from within the theoretical framework of Gibsonian ecological psychology, an alternative approach to the information processing theories that dominate contemporary psychological theorising.

Four experiments were conducted that employed an original set of ecologically valid facial displays generated specifically for the present research. In Experiments 1a and 1b, it was demonstrated that when judging from either photographs or video, participants could determine whether a smile reflected a positive emotional experience or not. Furthermore, for both of these studies, participants exhibited a bias toward misidentifying posed smiles that expose the teeth as genuine smiles. Experiment 2 also revealed findings consistent with the notion that perceivers are sensitive to the meaningful differences between posed and genuine smiles. In this study, participants were required to judge the valence of a series of target words, each of which was preceded by a briefly presented facial expression (i.e. a prime). The results of this study indicated that the identification of positive words was facilitated when preceded by a genuine smile, but not a posed smile. Experiment 3 was conducted to further investigate how such sensitivity may be manifest in regard to guiding effective social interaction. Participants were required to play several rounds of the Prisoners' Dilemma game with partners (actually video recordings) exhibiting

either posed or genuine smiles. The results of this experiment indicated that genuine smiles facilitated cooperative interaction, but posed smiles did not.

The results of all four experiments are discussed in terms of the functionality provided by accurate social perception with regard to the acquisition of information specifying the emotional state, and more broadly, the dispositional properties of conspecifics. Finally, these results will be considered in terms of the ecological conceptualisation of psychological activity, with an emphasis on the social affordances specified by posed and genuine smiles respectively.

CHAPTER 1

Emotion, Smiling and Social Interaction

Detection of the dispositional properties belonging to the people, places, and things of the environment is a fundamental capacity of human cognition. Basic survival needs are often met simply by knowing what may harm us, what may help us or what we need to know more about. Such knowledge equips us to avoid the dangerous, approach the beneficial or explore the unknown. Moreover, the environment contains a wealth of information specifying just such properties. We can tell whether fruits are ripe from their hue, the likelihood of rain from cloud formations, the sex of a stranger from their gait, and so on. By attending to the relevant properties of the environment we are able to shape our activity toward realising goals and avoiding harm. In this sense, perception guides action in an adaptive, functional manner. The information we acquire regarding the people, places, and things of the environment helps steer us toward biologically adaptive behaviour.

The functional nature of perception takes on an especially significant role when engaging with others. Successful social interaction requires the accurate acquisition of information relevant to the dispositional properties of others. Along with more stable characteristics such as age, sex, and identity, an awareness of the emotional state of interaction partners proffers considerable advantage for the social perceiver. By attending to indicators of another's emotional state the perceiver can acquire knowledge helpful for guiding interaction with that person. Knowing that someone is angry will tend to lead to quite different types of interaction in comparison to knowing they are happy. It is advisable to be more wary of an angry than a happy individual if one wishes to avoid harm. Again, in interactive situations perception guides behaviour in a functional manner; the information we acquire regarding other people's emotional states helps guide us toward socially adaptive encounters.

Thus, it follows that the social perceiver will enjoy adaptive advantage by being sensitive to information specifying the dispositional properties of others. Knowledge of the socially relevant qualities of others allows the perceiver to tailor their own behaviour toward achieving desirable and successful interactions and avoiding potentially harmful transactions. However, the utility of such perception-action cycles may be compromised if the interests of the interaction partners do not correspond. What is adaptive for one person in a dyadic interaction may not be adaptive for the other. For instance, if one is angered sufficiently to want to harm another, signalling this intention by providing information about emotional state may actually thwart the achievement of this goal. Upon recognising expressed anger, the perceiver is granted an opportunity to anticipate potential harm and behave accordingly (perhaps by fleeing, pre-emptively attacking, or attempting some form of non-violent conflict resolution). Consequently, in the context of social exchange, there may often be incentives to employ some form of disingenuous signalling (e.g. pretending to be happy when actually angry). In this situation, the social perceiver needs to be sensitive to the difference between information that actually specifies a disposition and attempts to simulate dispositional information or else risk being deceived and losing the adaptive function accurate social perception brings.

The present research utilises the notion of the functional nature of social perception to investigate the sensitivity of perceivers to information specifying positive emotional state. In particular, the focus of the current research relates to the function of detecting information specifying a positive emotional state by means of facial expressions, specifically posed and genuine smiles. While the latter are spontaneous, genuine expressions of emotional state, posed smiles are intentional communicative mechanisms usually intended to simulate an emotional state. In this sense it is important for the social perceiver to be sensitive to any meaningful differences between posed and genuine smiles or risk misperceiving the relevant opportunities for adaptive interaction with an individual exhibiting a smile.

This chapter outlines an argument regarding the adaptive function that the accurate detection of the emotional state of others provides the social perceiver. Initially, relevant approaches to the study of emotion will be reviewed with a focus on functional accounts of emotion as well as the link between emotional experience and facial expression. Subsequently, evidence will be presented that suggests systematic physiological and psychological distinctions exist between posed and genuine smiles that are manifest physiognomically and are therefore available to be perceived. Finally, consideration will be given to a recent theoretical account of the evolution of smiling in humans that posits that genuine smiles were selected for as an effective mechanism of fostering cooperation by means of eliciting positive emotion in others.

Emotions and Emotion Theory

Intellectual interest in human emotion can be found in the writing of many of the great philosophers from history. Plato and Aristotle both wrote of the place of emotion in their respective considerations of the human condition, as did Descartes and Darwin to name only a very few significant contributors. Modern psychology has strong roots in emotion theory and research, which is evident by the seminal works produced by James (1884; 1890), Lange (Lange, 1885), Cannon (1929) and Freud (Breuer & Freud, 1895/1960). More recently, the rise of cognitivism within psychology has seen a proliferation of theorising and research concerning emotion (e.g. Ekman, 1994; Frijda, 1953; Izard & Bartlett, 1972; Lazarus, 1991; Plutchik, 1962; Schachter & Singer, 1962; Tomkins, 1962). As may be expected the views within this body of literature represent different theoretical and empirical approaches to the study of emotion potentially as diverse as those exhibited in the study of psychology itself. Contemporary accounts of emotion range from those that establish the foundations of emotion in biology (e.g. Buck, 1999) and evolution (e.g. Cosmides & Tooby, 2000) to strictly social constructionist approaches whereby emotions are conceptualised principally as learnt responses (e.g. Harre, 1986). Clearly then, a comprehensive review of the literature pertaining to emotion is well beyond the scope of this thesis. However, the present approach relies on concepts relating to emotion and emotional experience as part of a functional description of aspects of social perception (also see Chapter 2) hence a brief review of relevant aspects from this literature is necessary. To this end, the following sections outline the dominant contemporary functional approaches to emotion. These theories establish a broad conceptual framework for arguing that emotions have an important role in coordinating social interaction.

Functional Accounts of Emotion

Although definitions of emotion are potentially as numerous as the theories to which they pertain, many researchers suggest that emotions function to help the individual cope adaptively with the contingencies of their environment (e.g. Ekman, 2003;

Frijda, Kuipers, & Schure, 1989; Izard, 1994; Plutchik & Conte, 1997). Often described as coming from a psychoevolutionary approach to emotion these theorists expand on Darwin's (1872/1998) early writing on emotional expression to suggest that emotions are multi-component, biologically based patterns of action and interaction that have been shaped by natural selection to serve specific ecological functions. Lazarus (1991) for instance, in one of the more thorough analyses of emotion, suggests that emotions occur in response to a meaningful appraisal of the person-environment relationship. Appraisal involves some form of appreciation of the potential for both harm and benefit in the relationship between the individual and their environment, which triggers a relevant emotional response specific to the appraised situation or, as Lazarus termed it, adaptational encounter. The emotional response is generally conceived as involving several inter-related components typically including phenomenal experience (Jones, 1995), physiological effects including changes to the endocrine system (Baum, Grunberg, & Singer, 1992), the autonomic nervous system (Ekman, Levenson, & Friesen, 1983), the central nervous system (Davidson, Ekman, Saron, Senulis, & Friesen, 1990) and the musculoskeletal system (Lynch, Bakal, Whitelaw, & Fung, 1991), and an expressive or communicative component (Fridlund, 2002; Pittam & Scherer, 1993), all operating in a coordinated and largely automatic manner (Ekman, 2003). It is in this sense that Fridja (1986) refers to the collective emotional response as changes in *action readiness*, that is, modes of relating to, or interacting with, the environment. Together, the various components of an emotional state regulate the interaction between an individual and their environment by promoting adaptive modes of behaviour that modify, establish, or terminate, aspects of this relationship.

Conceptualising emotions as multi-componential modes of relating to the environment suggests there may be as many emotions as there are potential types of person-environment interactions. However, if this were the case, the concept of emotion becomes nebulous and meaningless. It would logically follow that the number of emotions, in parallel with the number of potential person-environment interactions, is virtually infinite, which in turn provides the construct of emotion with little, if any, descriptive or explanatory power. Instead, most theorists of emotion attribute a specific structure or organisation to emotion based on the fundamental adaptive utility a particular emotional response may provide. It is common for theorists describing functional accounts of emotion to prescribe adaptive benefit to a small set of discrete *basic* or *primary* emotions (Plutchik, 2003). For example, Ekman and Friesen (1975) suggest there are seven primary emotions[1] based around universal themes or events that are common "to the welfare and survival of all human beings" (Ekman, 2003, p.23), a concept Lazarus (1991) referred to as a *core relational theme.* Alternatively, Izard and Bartlett[2] (1972) and Tomkins[3] (1962; 1963) both propose a greater number of basic emotions than has Ekman, while Panksepp[4] (1982) suggests fewer. Plutchik (2003; Plutchik and Conte, 1997) describes a multi-dimensional model of the structure of emotion whereby emotions are represented along the dimensions of intensity, similarity and bipolarity, while Lazarus (1991) describes the primary emotions in terms of six components of the appraisal process (goal relevance, goal congruence, ego-involvement, blame, coping and expectation), which in combination distinguishes each emotion from others. Clearly, with regard to the

[1] Ekman and Friesen's (1975) list of primary emotions includes: sadness, anger, fear, surprise, disgust, contempt, and happiness.
[2] Izard and Bartlett (1972) suggest fear, anger, enjoyment, interest, disgust, surprise, shame/shyness, contempt, distress, and guilt are the primary emotions.
[3] Tomkins (1962; 1963) suggests fear, anger, enjoyment, interest, disgust, surprise, shame, contempt, and distress are the primary emotions.
[4] Panksepp (1982) suggests fear, rage, panic, and expectancy are the primary emotions.

theoretical appraisals of the function of emotion there is an observed taxonomic structure that, although varying in specific detail between theorists, describes a relationship between an individual and the contingencies of their environment.

Although the functional theorists of emotion clearly differ in regard to the exact structure of the taxonomy of emotion, two common themes emerge from their discussions. First, it is generally accepted that while emotions can be classified into discrete categories, emotions rarely occur singularly (Ekman, 2003; Lazarus, 1991). Often emotional responses are made up of combinations of more than one primary emotion. To illustrate, Plutchik (2003) compares, by analogy, his structural model of emotions with the colour solid first conceived by Sir Isaac Newton. Primary colours (red, yellow and blue) can be combined to produce secondary colours (green, orange and purple) all of which in turn can be mixed at varying intensities to produce a great number of colours. Furthermore, complementary colours (analogous to bipolar emotions), when mixed tend to cancel each other out, producing differing shades of grey. Plutchik goes on to suggest that "neither colours nor emotions are clear-cut categories with sharp boundaries" (p.103). While this may well be the case, it does not undermine the utility of classifying emotions (or colours for that matter) into discrete primary categories. The frequency with which any particular emotion, or combination of emotions may occur does not determine the underlying reality of the emotion, but merely suggests that the nature of a given emotion as it pertains to a given person-environment transaction is likely to be the result of a complex set of interacting factors.

Second, the proposition that emotions have a functional, biologically based evolved component implies a degree of universality among emotions (McNaughton, 1989). Most theorists are quick to acknowledge that a claim of panculturalism of emotion need not suggest that emotions are mechanistic, programmed responses to specific environmental contingencies, but that emotions share a functional similarity across individuals and situations (Griffiths, 1997). The precise nature of the context for a given emotion may vary between individuals, but the function of that emotion is very similar for all. For example, not everybody experiences fear toward the same events. Ekman and Friesen (1972) contrasted self-reports of fearful events from members of a preliterate culture in Papua New Guinea with those of citizens of an urban American city. While the former reported being frightened by being attacked by wild pigs, the latter reported being frightened by being attacked by muggers. Although the context for each event is very different, both events represent the potential for harm to the individual and therefore are seen to be accompanied by the same fearful response. As Griffiths suggests, examples such as this one demonstrate "that people in all cultures respond in a similar way to things that frighten them. They do not show that people in all cultures are frightened of the same things" (p.55). It is the functional specificity of emotion that is implied when claims are made regarding the apparent universality of emotion, rather than an invariance of the precise antecedent events that give rise to a particular emotional response. Further consideration will be given to the empirical evidence for the pancultural nature of emotion in subsequent sections.

Social Functions of Emotion

Beyond the intrapersonal function of informing and preparing the individual to cope adaptively with the demands and opportunities of their environment, emotions have been prescribed important interpersonal functions (Keltner & Haidt, 1999, 2001; Lazarus, 1991). Not surprisingly, research that considers the social functions of emotion has typically been focussed on the communicative aspects of emotion including vocal and postural cues to emotion, and in particular facial expressions of emotion. The fact that emotions have expressive, observable components provides a means for perceivers to know about the emotional state of others, which in turn helps facilitate the coordination of social interactions. Consistent with Fridja's (1986; Fridja & Mesquita, 1994; Fridja & Tcherkassof, 1997) notion of action readiness, knowing the emotional state of an interaction partner provides information pertinent to their likely intentions (Fridlund, 2002) and future behaviour (Keltner & Gross, 1999) to which the perceiver can then respond accordingly. Furthermore, if emotion is thought of as some means of regulating the person-environment interaction, it may be the case that the detection of the emotional state of another person also communicates information about meaningful events in the environment. Children often use information about the emotional state of caregivers to inform their own behaviour. For instance, Sorce, Emde, Campos and Klenert (1985) demonstrated that infants were more likely to cross a visual cliff when their mother was looking happy (e.g. smiling) compared to when she was looking fearful (e.g. displaying a facial expression of fear).

In a related sense, Keltner and Haidt (1999) also suggest that expressions of emotion can elicit complementary and reciprocal emotions in others. As another case in point, Dimberg and Ohman (1996) reported that upon the detection of a facial display of anger, participants responded fearfully even though the presentation time of the angry face was insufficient to enable participants to report what they had seen. Interestingly, this effect was only found when the apparent attention of the angry facial display was directed toward the participant (Dimberg & Ohman, 1983). If it appeared as though the gaze of the facial display was not focussed on the participant (i.e. the target was attending to something or someone else), no such fearful response was observed. This finding exemplifies the highly social nature of facial expressions of emotion in that only when the participant was the focus of attention (i.e. eye contact was made with the target) was their emotional response conditional on the target's facial display. Similarly, other researchers have reported a contagion effect for expressions of emotion whereby there is a tendency to experience emotions similar to those expressed by companions in order to help synchronise social interactions through shared experience (Hatfield, Cacioppo, & Rapson, 1992).

These examples demonstrate a functional role for the expression and detection of emotional states in social contexts. Knowing about the emotional state of others can help organise and coordinate social interaction. However, as aforementioned, such a function relies heavily on a coupling between the information specifying an emotional state and the actual emotional state of an individual. There is little utility in detecting information specifying an emotion in others if, for instance, the person who looks angry, is not angry. Believing erroneously that someone is angry may be quite dysfunctional, if, for example, interactions with a supposedly angry person are avoided unnecessarily. It is therefore important to consider the ontological basis for expressions of emotion. The next section provides a brief overview of research that has considered one means by which the perceiver can potentially gain knowledge of the emotional state of others: the facial expression.

Facial Expressions of Emotion

It is widely acknowledged that modern research on facial expressions of emotion has grown in large part from Darwin's (1872/1998) seminal work in the area of emotional expression. Darwin was among the first to claim that facial expressions of emotion were innate expressions of emotional states. Specifically as a challenge to the dominant view of the time that God gave humans facial muscles for the purpose of expressing emotion (Russell & Fernandez-Dols, 1997), Darwin, drawing from his earlier theory of natural selection (Darwin, 1859), proposed that expressions of emotion were vestiges of responses in ancestral species. Based on an anatomical description of the musculature of the human face provided by French anatomist Duchenne de Bologne (1862/1990), together with careful comparative observation, Darwin drew many parallels between human expressions and those of other species suggesting that homologies between human and non-human emotion indicated a common progenitor:

> With mankind some expressions, such as bristling of hair under the influence of extreme terror, or the uncovering of the teeth under that of furious rage, can hardly be understood, except on the belief that man once existed in a much lower and animal-like condition. (p.19)

Darwin did not believe that expressions of emotion evolved in order to fulfil some form of communicatory function, but that such function had been acquired and retained in the form of a secondary adaptation after the original adaptive purpose of these expressions had declined (Griffiths, 1997). For example, in the ancestral environment (and paralleled in modern non-human primates) the baring of teeth during anger may plausibly have been related to a preparation to attack, an action that therefore may have conferred some survival value. Although contemporary human expressions of anger frequently involve exposure of the teeth (Ekman, 2003), social and cultural influences mean that it is now far less likely to be in preparation for fighting or biting. However, such behaviour may still have a use. While the original function of exposing the teeth may have been lost, a secondary, function has been acquired, namely the communication of aggression or anger to conspecifics. As Griffiths has noted: “a behaviour originally associated with an emotion because it fulfils some function will not cease to be associated with the emotion simply because it has ceased to serve that function” (p. 65). Due to the past association between an emotion and expressive behaviour, the signal value of the expression may be sufficient for that expression to remain part of the species’ behavioural repertoire in the absence of the original function. In this sense, the reliable association between an overt behaviour and a dispositional quality provides the basis for the development of a system of communication. Thus, in Darwin’s view, facial expressions of emotion were biologically linked to an underlying emotional state, but had acquired contemporary function as a means of nonverbal communication.

Darwin’s work on facial expressions of emotion was largely ignored by psychologists until the mid to late 1960s. During this time the prevailing view regarding facial expressions of emotion was that they were learnt, culturally specific displays that potentially showed little overlap between various populations (e.g. Birdwhistell, 1963). However, when empirical evidence was sought to confirm this position the results revealed a consistency in the interpretation of the meaning of various facial expressions across a range of distinct cultural groups. In a number of early studies (e.g. Ekman & Friesen, 1971; Ekman, Sorenson, & Friesen, 1969; Izard, 1969) recognition rates of six facial expressions of primary emotions (i.e. sadness, anger, fear, disgust, surprise and happiness) were shown to be greater than chance regardless of the cultural group to which the judge belonged. Importantly these studies utilised a wide range of cultures including preliterate groups from Borneo and New Guinea (Ekman et al., 1969), and a media-isolated group of Fore also from New Guinea (Ekman & Friesen, 1971). The latter group, the Fore, had never seen movies, television or magazines, did not speak or understand English or pidgin English and had not lived or worked in any settlement or town with Westerners. Ekman and Friesen also reversed the standard recognition test with this group by telling them a story (e.g. about the death of a child) designed to involve only one emotion and asking them, via interpreters, to show how their face would appear if they were the person in the story. Videotapes of these expressions were then shown to American college students who were able to accurately recognise the intended emotion. Considering this early research as a whole, although some variation in recognition rates was observed both between expressions and between cultures, these researchers were able to conclude that for a certain range of facial expressions there was a universal understanding of what a given expression meant that was independent of any form of cross-cultural learning. A recent meta-analysis of 97 studies of cross-cultural facial expression recognition conducted by Elfenbein and Ambady (2002) confirmed these findings, concluding that "evidence for the cross-cultural recognition of emotions…suggests that certain core components of emotions are universal" (p.228).

However, further research has suggested that the expression and recognition of emotion may not be as linear and straightforward as initially conceived. Ekman

(1971) reported an experiment comparing the spontaneous facial expressions exhibited by Japanese and American college students. Participants were required to watch a film previously shown to elicit similar amounts of self-reported stress in both groups while alone in a room. Although each participant was aware that various physiological recordings were being taken during the film, they were not aware that their facial expressions were being recorded by video. Correlations between the facial expressions displayed by each group of participants revealed a high degree of consistency in facial movements between the groups when viewing the film, indicating that the Japanese and American participants exhibited similar expressions. However, when the procedure was repeated with an experimenter from the same culture as the participant present, differences between the groups emerged. Specifically, the Japanese participants appeared to show relatively more positive, and fewer negative emotional expressions than did the American participants, whose facial expressions remained similar to when they were watching the film alone. When the videotapes of the Japanese participants were examined in slow motion, brief, momentary traces[5] of negative facial expressions that were rapidly replaced with a smile were observed. The Japanese participants appeared to have masked facial evidence of their negative emotions with a smile. Ekman described this phenomenon in terms of the use of *display rules*, culturally defined norms and conventions regarding when and to whom it is appropriate to exhibit emotion[6]. For the Japanese participants in this study, custom deemed that it was not appropriate to display negative emotion in a social setting (McNeill, 1998). Although the evidence

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[5] Often termed *microexpressions* (Ekman & Friesen, 1969)

[6] Display rules are thought to be very common among groups of all varieties. Ekman (1971) suggests display rules may operate according to individual characteristics (e.g. age, sex, identity etc.), setting characteristics (e.g. funeral, party etc), social roles (e.g. dominant, authority etc.) and interaction characteristics (e.g. playing, talking, listening etc.). Management of expression may entail increasing or decreasing the intensity of the expression, looking neutral (expressionless) or masking the felt expression with a simulated expression of another emotion.

suggested that for all participants the same negative emotions were experienced when viewing the film alone and when accompanied by an experimenter, the Japanese participants attempted to hide signs of such experience from others.

While the results reported above do not undermine the view that affective facial expressions have a biological basis, they do suggest that factors in addition to experienced emotion influence expression. The presence of an audience led to the management of emotional expression according to socially constructed convention. Indeed, social context has been shown to play a significant role in the expression of emotion in naturalistic settings. Kraut and Johnston (1979, study 2) report an ethological study concerning the influence of social context on the frequency and incidence of smiling amongst people ten-pin bowling. Although bowlers smiled relatively rarely, the incidence of smiling was approximately nine times greater when the bowler was facing toward friends compared to when facing toward the pins. Furthermore, smiling was not associated with the quality of the bowl delivered. In this study it appeared as though smiling was induced to a greater extent by social factors (i.e. smiling at friends) than emotional factors (i.e. smiling following a good performance). Similar studies have also been carried out experimentally. For example, Hess, Banse and Kappas (1995) systematically varied the social context, the intensity of emotional experience, and the relationship between the participant and their audience in order to uncover which of these factors predicted the display of facial expressions. The authors reported that no one factor alone could be used to predict the intensity of facial expressions observed. Instead, a complex interplay of all three factors needed to be considered. Comparable findings have also been reported by Jakobs, Manstead and Fischer (1999) and Bonanno and Keltner (2004), whereby both the experience of emotion and the social context for such experience have bearing on facial expression.[7]

In relation to the present research, the notion that facial expressions are not always literal read-outs of emotional experience underscores the importance of accurate detection on the part of the social perceiver. Given that expressions are often managed in accordance with context and convention, perceivers cannot always rely on a given expression necessarily being linked to any specific underlying emotional state. Any particular example of facial efference may be an expression of emotion, an intentional display, or a mixture of both. While an expression of emotion may convey information to the perceiver that is relevant to coordinating smooth social transaction, an intentional expression may do quite the opposite in that advantage may be gained by voluntarily signalling a false intention. Smiling when angry for instance, may fool an interaction partner into a potentially dangerous engagement. Thus, the adaptive social perceiver needs to be sensitive not only to emotional state as specified by facial expression, but also to simulations of emotional state in the sense that these expressions are not veridical expressions of any reliable social information, but instead represent managed forms of nonverbal communication. In the next section, research will be reviewed that suggests there are meaningful psychological distinctions between spontaneous genuine smiles as expressions of positive emotion and intentional simulations of this expression or posed smiles which are manifest physiognomically and are therefore available for perception.

[7] Some researchers have interpreted these and other findings to suggest that facial expressions should not be thought of as being grounded in emotional experience, but instead only as mechanisms of communication of social intention (e.g. Chovil, 1997; Fridlund, 1994; Fridlund, 1999; 2002; Provine, 1997). Among the proponents of this view, Fridlund has been the most vociferous and thorough, proposing the Behavioral Ecology View as an alternative theory of facial expression. Fridlund's approach as it relates to smiling is considered in more detail below.

Posed and Genuine Smiles

The French neurologist and anatomist Duchenne de Bologne (1862/1990) was the first to report systematic differences between smiles that were spontaneous expressions of positive emotion and those that were intentional or posed expressions. He suggested that:

> The emotion of frank joy is expressed on the face by the combined contraction of the *zygomaticus major* muscle and *orbicularis oculi*. The first obeys the will but the second is only put into play by the sweet emotions of the soul; fake joy...cannot provoke contraction of this muscle....The muscle around the eye does not obey the will; it is only brought into play by a true feeling, by an agreeable emotion. (p.126)

Duchenne had been examining the physiognomic effects of electrical stimulation of individual facial muscles. Originally using human heads collected from the guillotine, Duchenne would touch electrodes to individual facial muscles and photograph the resulting contractions. However, this method was rather unsatisfactory as the facial nerves would only reliably conduct electricity for a few hours after beheading, providing Duchenne with only a short time frame in which to conduct his research (McNeill, 1998). To overcome this limitation, Duchenne hired an elderly man who was suffering from a form of facial anaesthesia which left him unable to feel pain in his face and who was therefore agreeable to the otherwise painful process of galvanisation. When Duchenne stimulated the *zygomatic major* muscle, which runs diagonally from the top of the cheek bone to the upper lip and pulls the outer corners of the mouth outward and upward in a characteristic smile shape, he noted that the resulting change in appearance did not give an impression of happiness. To provide a basis for comparison, he told his subject a joke and photographed the reaction. The facial expression occurring in response to the joke showed evidence of contraction of the muscle that surrounds the eyes, *orbicularis oculi* (which pulls the skin surrounding the eyes toward the eye-ball) in addition to *zygomatic major* contraction. This observation led Duchenne to draw the conclusion that contraction of the *orbicularis oculi* was a reliable marker to distinguish genuine smiles of enjoyment from intentional or posed smiles.

In the following century, Duchenne's (1862/1990) observations were largely ignored by scientists of facial expression. However, during this time, much was learnt in regard to the functional neuroanatomy of the face, findings which provided support for the conceptual basis for Duchenne's conclusions regarding the distinction between posed and genuine smiles. Of particular relevance to Duchenne's notion that some of the muscles of the face are not under voluntary control is the suggestion that relatively distinct neural pathways separately innervate voluntary and involuntary facial movements (Rinn, 1984). In a neurological sense, voluntary facial movements originate from areas in the motor cortex, predominantly in the left hemisphere, and are innervated via the pyradimal tract (Gazzaniga & Smylie, 1990). By comparison, spontaneous facial movements employ phylogenetically older neural pathways originating in the sub-cortical areas within the brain (according to Damasio (1994), specifically the anterior cingulate region, limbic cortices and basal ganglia), which innervate the facial muscles via the extra-pyradimal motor system (Gazzaniga, Ivry, & Mangun, 2002). Clinical evidence for the distinction of these neural pathways can be observed in stroke patients. Patients who have experienced damage to the motor cortex show asymmetrical voluntary facial movements, but symmetrical involuntary expressions. In contrast, stroke patients with damage to the anterior cingulate region exhibit an asymmetry contralateral to the damaged hemisphere during spontaneous facial expressions, but no such asymmetry when wilfully contracting their facial muscles (Damasio, 1994). Such is the reliability of the neurological distinction between voluntary and involuntary facial movements that prior to the use of soft-tissue imaging, facial movements were used as diagnostic criteria for brain injury (DeJong, 1979).

The nature of the neurological distinction between volitional and spontaneous facial expressions supports Duchenne's original observations regarding posed and genuine smiles. Damasio (1994) suggests that while the *zygomatic major* can be contracted either wilfully or involuntarily (i.e. is innervated by both the pyradimal and extra-pyradimal motor systems), *orbicularis oculi* is not under volitional control. In support of this claim, Ekman, Roper and Hager (1980) demonstrated that while most people can deliberately contract the medial aspect of *orbicularis oculi*, only around 20% of the population are able to voluntarily contract the lateral aspect of this muscle. Importantly, as noted by Duchenne and later confirmed by Ekman, Friesen and O'Sullivan (1988), it is only the lateral parts of *orbicularis oculi* that are recruited when spontaneously expressing positive affect. Thus, it appears there is sound neurological support for the distinction made by Duchenne between posed and genuine smiles, in terms of both the conceptual difference between facial muscles that can and cannot be wilfully contracted, as well as evidence that the specific muscles Duchenne claimed to distinguish posed from genuine smiles (i.e. *zygomatic major* and *orbicularis oculi*) conform to this distinction.

Physiognomy of Posed and Genuine Smiles

Over 100 years after Duchenne (1862/1990) published his views on the distinction between posed and genuine smiles, Ekman and Friesen (1982) revisited his original observations. Drawing on the relevant literature since Duchenne, Ekman and Friesen proposed that there were potentially five markers that distinguished posed from genuine smiles, namely the Duchenne marker (*orbicularis oculi* contraction), the symmetry of *zygomatic major* contraction, the smoothness of contraction, the duration of expression, and the degree of synchrony of action. Each marker will be considered below in terms of the evidence suggesting its utility for differentiating posed from genuine smiles. The ontological status of each respective marker with regard to emotional state is noted. For reference, photographic examples of posed and genuine smiles are displayed in Figure 1.

Figure 1: Photographs of a posed smile (left) and a genuine smile (right).

Duchenne marker.

By far the most thoroughly researched indicator of a genuine expression of a positive emotional state is that originally proposed by Duchenne[8] (1862/1990). Specifically, the Duchenne marker consists of contraction of the *orbicularis oculi pars lateralis* (hereafter referred to as *orbicularis oculi*) muscle in concert with contraction of the *zygomatic major* muscle. While all smiles involve contraction of the latter muscles to pull the corners of the mouth obliquely upward in an expression characteristic of the prototypical smile, only spontaneous genuine smiles of enjoyment also involve contraction of the former muscles. Importantly, contraction of *orbicularis oculi* (also more commonly known as the eye-sphincter muscle) pulls the skin surrounding the eye toward the centre of the eyeball resulting in a number of observable changes in the appearance of this region of the face. Most notably, contraction of *orbicularis oculi* causes wrinkles or crow's feet at the outer corners of the eye socket which extend radially away from the eyes as well as a raising of the cheeks, bagging or bulging of skin below the eye and a pulling of the lower eyelid up toward the eye. More subtle changes involve a pulling of the skin above the eye slightly down and inwards, a narrowing of the eye aperture and a slight lowering of the eyebrows (Frank, 2002). In short, contraction of *orbicularis oculi* results in visible changes around the eye region.[9]

Evidence that the Duchenne marker can be used to reliably determine whether or not a given smile is accompanied by a positive emotional state has been reported across a variety of domains. Ekman, Friesen and O'Sullivan (1988) provided one of the first

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[8] Hence the term: Duchenne marker (Frank, 2002)

[9] Although, as Frank (2002) points out, intense contraction of *zygomatic major* may result in the bunching of skin below the eyes which may be mistaken for *orbicularis oculi* contraction. In this situation, only the pulling of the skin above the eye toward the eyeball and the lowering of the brow will provide unambiguous evidence of *orbicularis oculi* contraction.

systematic demonstrations of such an effect by employing a deception scenario in which participants were required to lie about any negative feelings they were experiencing. Specifically, while being surreptitiously video-taped, nursing students were asked to watch two films, one of a nature scene designed to be relatively pleasant and elicit positive emotions, and one showing amputation and burn scenes designed to be unpleasant and elicit strong negative emotions. Their task was to convince the interviewer they were watching the pleasant film regardless of which film they were actually watching. This involved concealing any negative feelings they may have experienced. To introduce a practical element the experimenters told the student nurses that the material they would be seeing was similar to that which may be encountered in an emergency room, where they may be required to conceal any fear, distress or disgust from the patient and their family. Furthermore, the participants were also informed that previous testing had indicated that their skill at the experimental task, as indexed by whether the interviewer could guess that they were lying, predicted their job performance. Ekman, Friesen and O'Sullivan reported that although the frequency of all types of smiles did not differ between the honest (pleasant film) and deceptive (unpleasant film) conditions, the frequency of smiles accompanied by the Duchenne marker was in fact different between conditions. Specifically, when participants were watching the film intended to elicit positive feelings they were more likely to exhibit smiles that included *orbicularis oculi* contraction compared to when they were watching the unpleasant film and attempting to conceal any negative responses. Smiles with the Duchenne marker present occurred more often when the participants were having a positive experience compared to when they were feigning such an experience.

Further evidence for the association between smiles that feature the Duchenne marker and positive emotional experience has been reported by Ekman, Davidson and Friesen (1990). In this study, participants were seated alone in a room while they watched both pleasant and unpleasant films. Facial expressions, subjective ratings of experienced emotion, and brain activity (measured using electroencephalogram, henceforth EEG) were recorded while the participant watched each film. Analysis of these recordings revealed a coherent pattern of results that linked smiles with the Duchenne marker to positive emotional experience across all measures. Participants exhibited more smiles with the Duchenne marker present when watching the pleasant films compared with the unpleasant films, but no such difference was observed for smiles that did not feature the Duchenne marker. Furthermore, the prevalence of smiles with the Duchenne marker was positively related to self-reports of positive emotional experience, and negatively related to self-reports of negative emotional experience. Finally, the EEG measures revealed a pattern of distinct brain activity when smiles with the Duchenne marker were expressed. These smiles were accompanied by relatively more left hemisphere central nervous system (CNS) activity than smiles that did not feature the Duchenne marker. Importantly, consistent patterns of CNS activity accompanying smiles with the Duchenne marker have been reported by Fox and Davidson (1988) who demonstrated that 10-month-old infants were more likely to exhibit smiles with the Duchenne marker when approached by their mother than when approached by a stranger. This finding is particularly significant in that it links both a context where positive emotion may be anticipated (i.e. an infant seeing his or her mother approaching), and a psychophysiological index of positive emotional state (i.e. CNS activity) with the spontaneous display of a genuine smile. A similar finding was also reported by Davidson et al. (1990) for participants watching emotionally laden films.[10] Thus, as the above laboratory studies demonstrate, there appears to be a reasonable degree of coherence between positive emotional experience and the exhibition of smiles that feature the Duchenne marker. Smiles that feature the Duchenne marker appear to occur in response to positive environmental events (e.g. watching a pleasant film) and are accompanied by a distinct pattern of neurophysiological activity along with self-report of a positive emotional experience. Alternatively, smiles without the Duchenne marker tend to show little relationship with context, no particular pattern of CNS activity, and are not related to reported positive emotional experience.

On the basis of the laboratory demonstrations of a reliable coupling between positive emotional state and the expression of smiles featuring the Duchenne marker it follows that similar observations should be apparent in more ecological settings. That is, we should expect to observe smiles with the Duchenne marker in contexts where individuals are known to be experiencing positive emotions and an absence of these smiles when there is no such affective state. To this end, pre-school children have been shown to display more smiles that feature the Duchenne marker after succeeding at a game, but more smiles without the Duchenne marker when they failed (Schneider, 1987). Happily married couples were reported to express more Duchenne marked smiles than those unhappily married, but no difference in other types of smiles existed between these groups (Levenson, 1989). In addition, Scherer and Ceschi (2000) reported that of those airline passengers whose baggage had been lost,

[10] Davidson et al. (1990) suggest that the pattern of left hemisphere activity found during smiles that feature the Duchenne marker is characteristic of an approach-related emotional response, while a similar pattern of right hemisphere activity is characteristic of a withdrawal-related emotional response (e.g. fear, disgust).

those who displayed smiles with the Duchenne marker were in better humour, as indexed by both self-report and the reports of airline staff, than those who did not.

Further support for the Duchenne marker as an indicator of positive affect has been reported in clinical settings. Clinically depressed individuals, as would be expected in line with their lack of positive affective experience, exhibit fewer smiles with the Duchenne marker than individuals who are not depressed (Berenbaum & Oltmanns, 1992; Katsikitis & Pilowsky, 1991), but show an increase in the frequency of expression of these smiles consistent with reductions in depressive symptoms (Steiner, 1986). Depressed patients admitted to hospital also displayed more smiles with the Duchenne marker at the time of their discharge compared with the time of their admission (Matsumoto, 1987). Consistent with the typical anhedonic symptomatology associated with schizophrenia, individuals experiencing this condition also tend to display fewer smiles with the Duchenne marker than do individuals without this condition (Berenbaum & Oltmanns, 1992; Keltner & Kring, 1998). Furthermore, Bonanno and Keltner (1997) reported that amongst adults who had experienced the death of a romantic partner, the incidence of smiles with the Duchenne marker during an interview 6-months post-loss was negatively associated with grief as measured 19 months later. Finally, Bonanno, Keltner, Noll, Putnam, Trickett, LeJeune and Anderson (2002) compared the facial expressions of children who had experienced some form of childhood sexual abuse, with the expressions of non-abused participants during interviews concerning distressing life events. The authors reported that smiles featuring the Duchenne marker were most prevalent among the children who did not have a history of abuse, and in fact the frequency of smiles of this type was negatively related to the total amount of lifetime trauma reported by each child.

Thus, from a cross-section of the literature, results indicate convergence of evidence to suggest that smiles which feature the Duchenne marker (i.e. contraction of *orbicularis oculi pars lateralis*) have an ontological basis in positive emotional experience. Smiles without this marker are not linked to affective state. Consistent with self-reports of positive emotional experience and a distinct neurophysiology, smiles with the Duchenne marker have been shown to occur more frequently in contexts where positive emotion would be expected (e.g. winning a game, being part of a successful relationship), and less frequently when positive emotion would not be expected (e.g. among those suffering depression or who have experienced trauma), thereby suggesting that genuine smiles of enjoyment can be identified by means of the presence or absence of the contraction of the *orbicularis oculi* muscle.

Symmetry.

The symmetry marker proposed by Ekman and Friesen (1982) consists of the bilateral contraction of the *zygomatic major* muscle. Ekman and Friesen predicted that genuine smiles of enjoyment would show symmetrical contraction of *zygomatic major*, distinct from posed smiles, which would show asymmetrical contraction of this muscle. Consistent with this suggestion, the literature provides some evidence to indicate that spontaneous expressions may in general differ from more voluntary expressions in terms of facial symmetry, with the former being more symmetrical than the latter (Gazzaniga & Smylie, 1990; Rinn, 1984). In relation to smiling, Ekman, Hager and Friesen (1981) reported that participants' spontaneous smiles in response to jokes were markedly more symmetrical than deliberately posed smiles requested by the experimenter. In a more detailed analysis, Hager and Ekman (1997) revealed that the contraction of both the *zygomatic major* and *orbicularis oculi* muscles were more symmetrical when participants were spontaneously smiling compared to smiles requested by the experimenter. Together, these studies provide evidence that the bilateral symmetry of facial action during a smile may indicate whether a smile is related to an underlying positive emotional state.

Smoothness.

The third marker predicted by Ekman and Friesen (1982) to differentiate veridical from non-veridical smiles involves the nature of the ballistic transition of the expression from the onset to the apex to the offset. They suggested that genuine smiles would show a regular flow of muscle contraction throughout the duration of the expression, while posed smiles would appear more irregular and abrupt, consistent with differences expected between voluntary and involuntary muscular contractions in general (Rinn, 1984). In support of this notion, Hess and Kleck (1990) reported that deliberate smiles contained more phases, that is, more pauses and categorical changes in intensity, than did spontaneous smiles. Furthermore, Frank, Ekman and Friesen (1993) reported that smiles containing the Duchenne marker were consistent in terms of the proportional duration of the onset, apex and offset components of the expression, but no such consistency was found for smiles without this marker. In fact, when the duration of each component was correlated with the others, significant patterns of relationships were revealed for smiles with the Duchenne marker present, but not for those without it. Frank (2002) has suggested that these findings indicate that genuine smiles, in terms of ballistic action, resemble a single behaviour rather than a combination of individual elements that coincide under deliberate control. This description is consistent with the nature of other involuntary movements and therefore is in support of Ekman and Friesen's prediction that the smoothness of the transition of the expression is relevant for determining whether a given smile is accompanied by a positive emotional experience.

Duration.

Ekman and Friesen (1982) also suggested that the overall duration of genuine smiles would be more consistent in comparison to the duration of posed smiles. Specifically, they predicted that genuine smiles would typically last for between 0.5 and 4 seconds, and that posed smiles would not conform to these temporal constraints and would therefore show greater variability of duration. Initially evidence strongly supported this prediction, with Hess and Kleck (1990) reporting that spontaneous smiles did indeed last between 0.5 and 4 seconds and that posed smiles were expressed for a significantly longer duration. However, further research conducted by Frank, et al. (1993) failed to replicate these findings. They reported no difference in mean duration of smiles that contained the Duchenne marker and those that did not. However, these authors did report a significant difference in the variability of the duration of the respective types of smile. Smiles with the Duchenne marker were less varied in terms of overall duration, while those without this marker were markedly more erratic. Although the precise nature of the relationship remains unclear, it appears as though the veracity of a smile may have bearing on the duration of that expression.

Synchrony.

The final physiognomic marker predicted by Ekman and Friesen (1982) to differentiate posed from genuine smiles concerns the degree of synchronisation between contraction of *zygomatic major* and that of *orbicularis oculi*. In particular, Ekman and Friesen suggested that the onset, apex, and offset of the contraction of these muscles would coincide in smiles linked to positive emotional experience. However, research to examine this claim has been scant. Although Frank, et al. (1993) reported that for smiles with the Duchenne marker the apex of *zygomatic major* contraction co-occurs with the apex of the smile considered as a whole, no research is known to have systematically compared the synchronicity of *zygomatic major* contraction with other facial muscles when contracted voluntarily. Therefore, the validity of the synchrony of contraction of *zygomatic major* and *orbicularis oculi* as a marker of a genuine smile of enjoyment has yet to be established.

Overall, it appears that four of the five markers proposed by Ekman and Friesen (1982) to differentiate posed from genuine smiles have been, to varying extents, validated by research. Clearly the contraction of *orbicularis oculi* has been the marker receiving the most attention by researchers, and there is now a substantive body of research to support Duchenne's (1862/1990) original observation. Smiles that show evidence of *orbicularis oculi* contraction have been demonstrated to coincide with self-reported positive emotional experience, specific patterns of neurophysiological activity, and within contexts in which positive experience may be expected. Importantly, smiles that do not exhibit these characteristics do not show any relationship to emotional experience, are not associated with any particular pattern of neural activity, and are often exhibited in contexts when a positive emotional experience would not be expected (e.g. watching an unpleasant film). In addition, smiles that occur in concert with positive emotion tend to be more facially symmetrical, show a smoother, more regular transition between onset, apex and offset, and are of a more consistent duration when compared with smiles that are not accompanied by positive emotion.

Of particular interest for the present research is the availability of the information specifying a genuine smile of enjoyment to the perceiver. If, as argued earlier, the social perceiver is well served by knowing the veracity of a given smile, then there must be information available for perception that reliably specifies this difference. As reviewed above, it appears as though such information is available during regular social interaction. The contraction of *orbicularis oculi* leads to changes in appearance around the eye region, most notably the appearance of wrinkles that extend radially from the outer corner of each eye. This information, along with the bilateral symmetry of the expression is potentially available for perception at any point during the unfolding of the expression,[11] and therefore may also be available in a static representation such as a photograph. On the other hand, the smoothness and duration of the expression have a temporal basis whereby at least a portion of the expression must occur for this information to be available. The smoothness and duration markers will therefore only be informative to the extent that the dynamic properties of the expression occur in a natural and unmediated manner. Outside of an actual interaction, smoothness and duration can only be represented by video. In short, the evidence indicates that there is information available to the perceiver to allow them to know whether a given smile occurs as a function of experienced positive emotion or,

[11] Although both the contraction of *orbicularis oculi* and expression symmetry are likely to be most prominent at the apex of the expression.

alternatively, is unrelated to emotional state. A part of the purpose of the present research is to investigate the sensitivity of perceivers to the information that specifies the emotional state of a smiling individual.

Alternative Accounts of Posed and Genuine Smiles

To this point, the account of posed and genuine smiles provided has been presented according to what is commonly described as the *emotions view*[12] of facial expressions (Fridlund, 2002). In brief, proponents of this approach (the most prominent being Ekman, e.g. Ekman, 2003), argue that there are there are approximately 7 ± 2 basic emotions, each of which has a unique facial expression that is both expressed and recognised panculturally. In this sense, facial expressions of emotion are thought to be inextricably linked to experienced emotions on the basis of some form of innate read-out mechanism. Expressions that do not conform to the universal set of expressions may be either blends of two or more emotions, or the result of socialised display rules, whereby expression becomes decoupled from emotional experience in order to meet social convention. On these grounds, smiles are argued to be distinct on the basis of whether they are a display of a positive emotional experience, or alternatively intentional simulations of such a display in the absence of positive emotion. However, this view is not the only approach that has been offered in terms of explaining facial expressions, or more specifically in this context, explicating distinctions between posed and genuine smiles. Several alternative theories have been proposed to explain the relationship between emotional experience and facial expressions. A brief critical review of the two more widely cited approaches, the behavioural ecology view

[12] This approach has also been described as the *facial expression program* (Russell & Fernandez-Dols, 1997)

(Fridlund, 1994, 1997) and differential emotions theory (Izard, 1990), is presented below.

Behavioural ecology view.

The behavioural ecology view of facial displays as proposed by Fridlund[13] (1991; 1994; 1997; 2002), posits that facial expressions are not read-outs of any particular emotional state, but instead are best understood as social signals which communicate to interaction partners an individual's intentions and anticipated behaviours. Fridlund argues that with respect to adaptive function, automatic signalling of emotional state by means of a facial expression of emotion is likely to be detrimental to the displayer, particularly when their goals may conflict with those of the interaction partner. Instead, expressions serve as a signalling mechanism that enables individuals to communicate social goals and motives in order to facilitate smooth social transaction. Accordingly, from Fridlund's view, smiles should not be considered to be expressions of a positive emotional experience, but rather as signals of an individual's intention to interact, appease, affiliate or the like. In fact, according to the behavioural ecology view, smiles do not carry any particular inherent meaning independent of the social context in which they are exhibited.

In support of this explanation Fridlund (1991; Fridlund, Kenworthy, & Jaffey, 1992) reported the results of laboratory studies which he claimed demonstrated that smiling was merely a display to serve social motives and therefore did not have any underlying link to emotional state. In these studies, participants watched pleasant films in a variety of social contexts (i.e. alone, alone but believing a friend was

[13] Although Fridlund has been the main proponent of the behavioural ecology view, other researchers (e.g. Chovil, 1991; Provine, 1997) have adopted similar, albeit less extreme versions of this approach.

nearby, alone but believing a friend was nearby engaged in the same task, or with a friend) while *zygomatic major* activity was measured using electromyography (henceforth EMG). Fridlund reported that the amount of smiling as indexed by EMG recordings was not related to self-reported emotion, but instead solely attributable to the social context. Those watching the film with a friend, or with the understanding that a friend was nearby (Fridlund described this condition as implicit sociality), displayed more smiles. In fact, the amount of smiling varied monotonically with the degree of sociality of the viewing conditions. No relationship was found between reported emotional experience and smiling.

However, a number of researchers have been critical of Fridlund's theoretical position and, as a consequence, of his research (e.g. Ekman, 2003; Frank, 2002; Hess et al., 1995). Clearly, the fact that only *zygomatic major* activity was measured to index smiling in the research described above indicates that this method is unable to shed any light on the relationship between experienced and expressed emotion. By failing to distinguish between smiles that feature contraction of *orbicularis oculi* and those that do not, there was no means to differentiate between smiles likely to be coupled with emotional experience and those that were simulated displays. It is not surprising that *zygomatic major* activity alone did not relate to self-reported emotion – no proponents of the emotions view claim that all contractions of *zygomatic major* are linked to emotional state, only contractions that co-occur with *orbicularis oculi* activity. Hess et al. (1995) provided a partial replication of Fridlund's studies and reported that emotional experience did in fact have bearing on facial expression.

Furthermore, the behavioural ecology view appears inconsistent with the available empirical data. Fridlund provides no explanation for the neuroanatomical differences between the innervation of spontaneous and deliberate expression, instead simply claiming that all expressions are volitional. Nor does he account for the neurophysiological distinctions observed between posed and genuine smiles (Frank, 2002). Thus, it appears that the behavioural ecology view of facial displays falls short in terms of providing an adequate account of either the existing theoretical explanations of facial expressions, or the empirical findings reported in the literature concerning facial expressions of emotion, specifically as they apply to the meaningful distinctions between posed and genuine smiles.

Differential emotions theory.

Initially proposed by Izard (1977), differential emotions theory, in contrast to the behavioural ecology view, claims that facial displays serve both expressive and communicative functions. Furthermore, proponents of this approach (e.g. Abe, Beetham, & Izard, 2002; Abe & Izard, 1999) claim that there is an innate concordance between experience and expression of emotion that has an evolutionary basis. Children are believed to be born with the capacity to express emotion and over the course of development learn to regulate these expressions in accordance with social conventions. To this point, differential emotions theory closely resembles the emotions view, however an important difference between the two approaches concerns the distinction between posed and genuine smiles. In contrast to Ekman and colleagues (e.g. Ekman & Friesen, 1982; Frank et al., 1993), proponents of differential emotions theory claim that the difference between smiles featuring contraction of *orbicularis oculi* and those that do not may be explained in terms of differences in the intensity of experienced emotion or, alternatively, the ability to regulate emotions. Abe, Beetham and Izard draw a distinction between full-faced expressions (e.g. a smile with both *zygomatic major* and *orbicularis oculi* contraction) and component expressions (e.g. a smile with only *zygomatic major* contraction), suggesting that the latter are "likely to reflect milder or more regulated emotions" (p.89). To support this view, these authors cite evidence showing that smiles without *orbicularis oculi* have been associated with positive emotional experience (e.g. Hess et al., 1995) and, in research with infants, linked to success in games (Schneider & Josephs, 1991) and social interactions (Messinger, Fogel, & Dickson, 2001). In addition they point out that *orbicularis oculi* contraction is also observed in relation to the expression of other emotions such as intense anger (Messinger, Fogel, & Dickson, 1997).

However, it is not clear that the research cited in support of differential emotions theory provides any evidence that is contrary to the emotions view. Social signalling and non-verbal behaviour can occur in concert with any emotional experience. The fact that smiles without *orbicularis oculi* contraction can be linked to positive emotional state may simply suggest that display rules are in operation. Given there is no isomorphic relationship between experience and expression of emotion (i.e. not every incidence of experienced emotion is expressed) it is reasonable to assume that individuals may be happy and simultaneously employ voluntary facial displays. Furthermore, contraction of *orbicularis oculi* in the context of an emotional experience other than happiness does not undermine the emotions view. No claims are made regarding the information specified by *orbicularis oculi* contraction alone, rather when this muscle contracts in concert with *zygomatic major* it is argued that positive emotion is expressed. In addition, the differential emotions theory does not account for the evidence of neuroanatomical or neurophysiological distinctions between posed and genuine smiles.

Thus, it appears that the emotions view provides the most comprehensive account of the available evidence whereby it is suggested that a categorical demarcation exists between posed and genuine smiles. Although both the behavioural ecology view and differential emotions view have provided serious and distinct challenges to the emotions view, neither approach is able to provide a comprehensive explication of the body of research that has to date examined, by various means and at various levels of explanation, the distinction between posed and genuine smiles. Hence, the present research is informed by the emotions view of facial expressions.

Posed and Genuine Smiles in Social Interaction

On the basis of the theory and research reviewed to this point it has been suggested that posed and genuine smiles may play an important functional role during social interaction. As has been discussed, emotions help equip the individual to cope adaptively with the contingencies of their environment. Frijda and Tcherkassof (1997), in explaining this phenomenon described the emotional response as a state of action readiness, enhancing the means by which an individual can "establish, maintain, or change a particular kind of relationship with some object in the environment or in thought, or with the environment as a whole" (p. 87). The emotional response is comprised of several components: typically physiological changes, phenomenological experience, and an expressive component. The latter has important implications for social interaction in that by attending to expressions of emotion, the social perceiver is able to acquire knowledge about the emotional state of conspecifics. To the extent that emotional experience is linked to behavioural consequences, such information is useful for predicting the likely future behaviour of others, and can therefore help facilitate smooth social transaction. However, if the interests of the parties of an interaction are in conflict, simulated expressions of emotion (i.e. attempts to appear emotional in the absence of emotional experience) may be employed to gain some form of advantage over interaction partners. For instance, posed and genuine smiles are seen to reflect the distinction between an intentional simulation of an expression of emotion and a spontaneous veridical emotional expression. While genuine smiles are indications of positive emotional experience, posed smiles appear to be generally unrelated to emotion. Given that there are physiognomic differences between posed and genuine smiles that specify honest enjoyment as opposed to that which is simulated, it follows that the social perceiver may use these distinctions to enable accurate detection of positive emotional state. However, to this point, little attention has been given to what, specifically, the social perceiver is detecting when differentiating between posed and genuine smiles. That is, what specific function does positive emotion play within the context of social exchange that makes it advantageous for the perceiver to be sensitive to the differences between veridical and simulated expressions of this emotion? To address this question, Owren and Bachorowski (2001) have recently presented a theoretical account of the evolutionary origins of smiling in humans. A brief overview of their account follows.

Selfish Genes and Smiling in Social Interaction

Owren and Bachorowski (2001) explicitly adopt a selfish-gene perspective from evolutionary biology (e.g. Dawkins, 1989) to describe and explain the evolutionary origins and function of smiling in early hominids and humans. Basing their argument on the rather controversial position that smiles are facial expressions that are more uniquely human than facial expressions of negative emotions,[14] these authors propose that smiling (and subsequently laughter) in the present form emerged as the result of selection pressure operating specifically on our hominid ancestors. That is, while the features of emotion necessarily evolved from a common ancestor of both modern humans and higher-order apes, smiles have undergone further selection at some point after these lines had diverged in response to changing ecological niches. Specifically, the shift from being arboreal to terrestrial dwelling creatures brought with it a range of new environmental challenges, not the least of which was the increased reliance on group living.

Successful living in extended groups requires the formation and maintenance of cooperative relationships between individuals who are often (relatively) genetically unrelated. However, truly cooperative behaviour may tend to be reasonably uncommon as, according to the selfish-gene approach, natural selection favours those who ultimately gain rather than lose from social interaction. Hence, any strategy of cooperation must be mutually beneficial for all parties; or else those who lose out may not cooperate in the future either by choice or consequence (i.e. being selected against). Furthermore, such a strategy must be resistant to an attempt to cheat, that is,

[14] Although Owren and Bachorowski (2001) acknowledge that some non-human primates express prototypically positive information such as a 'play-face' or laugh-like pants in chimpanzees, they suggest these expressions primarily serve functions distinct from the expression of positive emotion, such as affiliation or appeasement.

to enter into a cooperative interaction, but not cooperate. To achieve stable cooperation, a system of reliable communication is required in order to minimise opportunities for dishonesty during otherwise cooperative interactions.

Accordingly, Owren and Bachorowski (2001) argue that smiling evolved in humans as a reliable indicator of a positive emotional state, which, in turn, led to the selection for accurate detection of this indicator. Crucial to this argument is the selection for both the expression and recognition of smiling in that both of these components are required to resist exploitation. Therefore, communication from this perspective is conceived not as information sharing, but an attempt to influence others. Detection of positive emotion in others leads to experiences of positive emotion (Surakka & Hietanen, 1998), thereby 'matching' the emotional state of interaction partners, which in turn is likely to lead to an escalation of the intensity of the positive emotional experience in a form of feedback loop between interaction partners. This feedback fosters positive affect between individuals, which according to Owren and Bachorowski, is an important causal component of reciprocal cooperative behaviour. Indeed, if either party of an interaction does not detect and respond to a signal of positive affect in kind, the feedback loop is broken and positive affect dissipates, as does the likelihood of cooperation. Thus, in essence, Owren and Bachorowski argue that genuine smiling has evolved in humans alongside the ability to detect this signal as a mechanism for eliciting reciprocal cooperation amongst interaction partners.

Of course, this system is still open to dishonest signalling in terms of simulating an expression of positive emotion, thereby eliciting cooperation without any necessity for reciprocation. However, as we have seen, simulations of smiles expressing positive affect are neurologically and physiognomically distinct from spontaneous, genuine smiles. There is, therefore, a basis for the attuned perceiver to discriminate between individuals who are genuinely cooperative and those attempting to elicit cooperation without possessing an intention to reciprocate. A focus of the present research centres on whether social perceivers do in fact use smile veracity to guide cooperative behaviour.

The Present Research

On the basis of the arguments outlined in this chapter for the adaptive function of the accurate detection of emotional state in others, the present research will provide an examination of the sensitivity of perceivers to positive emotional state as specified by posed and genuine smiles. This very notion was the subject of an early investigation by Darwin (1872/1998), who, after showing Duchenne's photographs of a genuine smile to a range of individuals, concluded that everyone could instantly recognise the expression as a smile of enjoyment. However, in regard to the photograph of the simulated smile, Darwin reported:

> That the expression is not natural is clear, for I showed this photograph to twenty-four persons, of whom three could not in the least tell what was meant, whilst the others, though they perceived that the expression was of the nature of a smile, answered in words such as 'a wicked joke', 'trying to laugh', 'grinning laughter', half-amazed laughter' etc. (p.202).

However, since Darwin's observation, in contrast to the research that has investigated the physiognomic distinction between posed and genuine smiles, there has been a paucity of research investigating the nature of the sensitivity of perceivers to these differences. The remainder of this thesis provides a review of the extant research investigating this issue, and presents the results of four experiments designed to replicate and extend these studies.

Initially, consideration will be given to the theoretical framework adopted for this thesis, that is, the Gibsonian ecological approach to psychology (Gibson, 1979), in order to outline the theoretical basis from which the empirical components of the present research were informed. Following this, consideration will be given to requirements for ecologically valid facial expressions for use in research settings. The procedure for generating the facial displays used in the present research is then described. Three experiments are reported. The first two studies were intended to investigate the sensitivity of perceivers to the meaningful distinctions between posed and genuine smiles; the first by means of an explicit discrimination task, and the second under conditions where the participant's attention was not drawn to any requirement to evaluate these facial displays. The third experiment was designed to investigate the functional role of posed and genuine smiles in social interaction. Specifically, this study was intended to provide a preliminary assessment of the social affordances specified by posed and genuine smiles by operationalising Owren and Bachorowski's (2001) theoretical proposition that genuine, but not posed smiles, elicit cooperative behaviour from interaction partners. Finally, consideration is given to the implications of the present research, both in terms of the results reported, as well as the application of an ecological framework to the study of social perception within psychological science.

CHAPTER 2

An Introduction to Gibsonian Ecological Psychology

The research reported in this thesis has been conducted from within the theoretical framework of Gibsonian ecological psychology. Given this approach has seldom been applied to the study of social perception (McArthur & Baron, 1983), the current chapter presents on overview of the study of psychology from a functional ecological perspective, contrasted with the more traditional mechanistic cognitivist treatments that dominate contemporary psychological theorising. Initially, a brief critical overview of the information processing approach to psychology will be presented as an introduction to the theoretical issues relevant to the present work. Subsequently, an outline of the Gibsonian ecological approach to psychology will be presented as an alternative theoretical position from which to study psychology. In particular, the focus of this chapter will be on the notion of direct perception and the theory of affordances, which together provide a basis for considering the individual-environment system as the unit of analysis for psychology. Consideration will be given to the suitability of an ecological approach for the study of social psychology and, more specifically, the phenomena of social perception. Finally, the present research will be discussed in terms of an ecological analysis of the function of posed and genuine smiles in the context of social interaction.

Cartesian Dualism, Ecological Monism, and Psychological Science

Virtually every branch of contemporary mainstream scientific psychology has at its core a theoretical commitment to the notion of a dualistic individual. Any cross-section of the discipline is likely to reveal the common assumption of a distinction between the mental and physical aspects of the human condition. That is, a distinction between the mind and the body, or in some cases the brain and the rest of the body. Such thinking is evident across the spectrum of psychological research ranging from the micro-level analyses of the neurosciences (e.g. Gazzaniga, Ivry, & Magnum, 2002) through to the study of psychophysiology (e.g. Cacioppo, Tassinary, & Berntson, 2000), sensation and perception (e.g. Schiffman, 1996), developmental psychology (e.g. Piaget, 1967), cognitive psychology (e.g. Anderson, 1995), evolutionary psychology (e.g. Barkow, Cosmides, & Tooby, 1992), personality psychology (e.g. Funder, 1997), social psychology (e.g. Carr, 2003) and extending to the more macro-level investigation of cultural and cross-cultural psychology (e.g. Berry, Poortinga, & Pandey, 1997).

The origins of the premise that the mental entity of the mind exists separately from the physicality of the body can be traced to the ancient Greek philosophers, and in particular Plato (Hacking, 2002; Trigg, 1988). However, it was the French philosopher and mathematician Descartes, who in the seventeenth century offered the theory of mind-body dualism that is seen in various forms throughout modern psychological science. After observing hydraulically mechanised statues in the Royal French Gardens, Descartes conceived of the human body as an organic mechanical device under the control of the mind, a distinctly separate non-mechanical, non-physical entity.[15] Although the separation of the body from the mind was certainly not a novel concept at the time, Descartes was among the first to emphasise a relationship between the two, suggesting a bidirectional link whereby the mind could influence the

[15] For Descartes, in keeping with the prevailing religious doctrine of the time, the mind was actually the soul (in fact, psyche originally meant soul), and could be located in the pineal gland. However, his ideas were not entirely in synchrony with the church in that the physical world was conceived by Descartes as entirely mechanistic, that once initiated by God needed no further divine intervention.

body as well as the body being able to influence the mind. For example, he suggested that the human 'passions' (e.g. love, hate, sadness) were bodily states that exerted influence over mental function, while in turn, mental function governed various bodily activities by means of controlling volitional action.

Information Processing Theories of Psychology

The central assumptions of Descartes theory of mind-body dualism have been so influential amongst theorists of modern psychological science that the term *Cartesian dualism* is now an accepted nomenclature to refer to a functional separation of the mental and the physical. Indeed, the advent of the cognitive revolution within psychology brought with it a rigorous endorsement of this form of dualism, derived in large part from the mechanistic approach of cognitive science to psychology. Typically, computational models of psychology have been a hallmark of the cognitive science approach (Eysenck & Keane, 1990), whereby the brain is conceived as a central processing machine that receives and interprets input from the sensory organs, and in turn issues commands to which the body responds. These ideas were very influential amongst the early cognitive psychologists (e.g. Broadbent, 1958; Miller, 1962; Neisser, 1967) and led to the formulation of a linear information processing approach as the dominant model within cognitive psychology (Anderson, 1995). Often represented as a computer metaphor of the mind, the information processing approach posits the brain (by analogy the central processing unit or hardware of the computer) as a device that processes information (by analogy the software of the computer) gleaned from the senses into a form that allows the perceiver to make sense of the world and ultimately behave in accordance with this interpretation.

Contemporary psychological science has drawn heavily on the information processing view of cognition, initially as an alternative to the 'black box' of behaviourism, and more recently as fully fledged theories of mental function and cognition (Leahey, 2001). Central to these theories is the notion of the mind as a mediating structure between the individual and the external world. By processing the sensory stimuli received from the environment, it is believed that the mind forms and stores mental representations of the external world in order that, by means of inferential processing, it can be meaningfully perceived. This internalised version of the world is assumed to be formed via sequential stages of information processing whereby the symbolic nature of the world is encoded into a meaningful mental representation which is subsequently accessed to inform behaviour (Anderson, 1995). Mental knowledge structures, often known as schema or schemata, (Eysenck & Keane, 1990) have been proposed in various forms by researchers (e.g. Bartlett, 1932; Piaget, 1967; Rumelhart, 1980) to explain the inner workings of the mechanisms of information processing. In short, a schema is a "structured cluster of concepts and…generic knowledge about stereotypical situations" (Eysenck & Keane, p. 249) that can operate as both a script for the execution of behaviour (Schank & Abelson, 1977) and a template for the integration of new knowledge into memory (Gluck & Bower, 1988). The schema, therefore, is seen to be a basic unit by which meaning is imposed on stimulus information in order for sense to be made of the world and behaviour exhibited accordingly. Thus, information processing accounts of psychology posit perception as an indirect process mediated by the mind.

Implications of indirect perception.

Theories of indirect perception, that is, perception mediated by the mechanistic processing of the mind, such as those proposed within the information processing approach to psychology, conceive of cognition in a manner explicitly consistent with that of Cartesian dualism. Although mental structures (e.g. schema) have been proposed to describe how a representation of reality is constructed from stimulus information, and further, how behaviour is informed by this representation, the mind remains both theoretically and functionally separable from the body, an assumption shared by both Descartes and modern mainstream psychology (Reed, 1996). Thus, theories of indirect perception are also necessarily dualist theories of psychology. Furthermore, inherent to psychological dualism is the theoretical assumption of construction, in that the mind must construct the reality with which the body engages. Hence, with dualism there comes a commitment to the notion of constructivism within cognition.

An important philosophical implication arises from conceiving of psychological activity as construction. If the mind is thought to construct meaning, it must be assumed that the sensory input arriving from the world via stimulation has no inherent meaning to the perceiver, that is, it arrives in an impoverished form (Michaels & Carello, 1981). Sensation resulting from stimulation of the sense organs is given meaning by way of the mechanisms of information processing before it can be coherently perceived. Thus, sensation and perception are seen as distinct but related activities, with the former involving the registration of stimulation by the sensory organs, while the latter refers to the constructive process by which this stimulation is prescribed meaning. Together, sensation and perception comprise the initial sequential stages of a chain of causality resulting in a response to the original stimulating conditions, that is, the initial stages of a stimulus-response cycle. The mind, or perhaps more correctly the information processing capabilities of the mind, are considered to construct a meaningful representation of reality from the input of the sense organs. Meaning, therefore, is seen as a property of psychological construction, not of the world. Thus, according to the information processing view, it is the mental models, schema and representations that provide the individual with an understanding of the world, not the world itself.

Ecological Psychology

The information processing approach to psychology has been widely accepted as a ubiquitous theory of psychology (Reed, 1996), and this view has indeed contributed much to the current understanding of human behaviour and psychological science in general. However, this approach has not been without serious philosophical criticism. Among the most vocal opponents to information processing have been a group of theorists and researchers promoting what has now come to be known as ecological psychology.[16] This theoretical approach has largely emerged from the work of J. J. Gibson (1950; 1966; 1979), who, upon recognising philosophical inadequacies inherent to the information processing approach to psychology, and in particular to the study of perception, set about devising an alternative theoretical view. Indeed, Gibson was not alone (e.g. Hirst, 1957) in identifying logical inconsistencies within the framework of mediational theories of perception. At the heart of such criticism is what Wilcox and Katz (1981) have termed the *cognitive paradox*. If it is accepted that

[16] It is important to note at the outset that ecological psychology as referred to in this and subsequent chapters does not refer to all approaches to psychology labelled ecological (e.g. Fridlund's (1991) behavioural ecology view of facial expressions), but to the theoretical approach of ecological realism first devised and championed by Gibson (1950; 1966; 1979), hence the label *Gibsonian*.

the mind (or brain) constructs representations of the external world in the form of schemas (or other such knowledge carrying mental structures), then one must question how such representations accommodate new information (or indeed how they came to exist in the first instance)? If knowledge is based in a schema, then something independent of that schema must be present, in order to know whether or not new information ought to be incorporated into the existing representation. Some other source of knowledge is required to decide whether incoming information needs to be encoded, or alternatively, is already represented within the existing schema. Schema themselves cannot logically perform this task since they are the knowledge structures potentially in need of change and therefore cannot simultaneously be the agents of change as they *cannot know what they do not know*. Wilcox and Katz illustrate the paradox as follows

> Suppose that all person X knows is what person Y tells him. How could X ever find that Y was lying? If X shows that he knows Y is lying, we have to conclude that we were wrong to believe that all X knows is what Y tells him. If we modify our position to include another informant Z, the same problem obtains. There might be a conflict between the reports of Y and Z, but X would have no way of deciding who to believe without information from another source. We can continue to multiply X's sources of information *ad infinitum*, but as we do so the claim that all he knows is what his informants (schemas) tell him will eventually become trivialised, because we would then say that all X knows is what every possible source of information tells him. (p.253)

Clearly, this reasoning becomes circular and somewhat fallacious when one begins to consider an infinite number of schema as the result of proposing higher and higher order knowledge structures. Reed (1996) takes a similar approach, questioning how schemas may operate to inform action. Reed suggests that in order for a representational system of knowledge to be of use, there must be some means to select "just those particular aspects of the representation that conveyed the information relevant to the task at hand" (p.11). To select such aspects of the representation, one must have an understanding of context (i.e. what is required by the current situation) independent of the representation, which again requires a means of knowing in addition to the representation. This same logical argument can be applied when considering the origin of schema in the individual. How does the newborn acquire their first schema? If the sensory world impinges on the newborn in a completely meaningless manner, how is meaning first applied in the absence of any schema, representation, or other knowledge structure? Thus, the paradox lies in the claim that knowledge is constructed cognitively, a process, which a priori requires the knowledge that it constructs, in order to perform the construction.

Gibson's solution to this paradox was to propose an alternate theory of perception that, as it developed, came to be antithetical to the information processing approach. At the heart of Gibson's theory, which he termed an ecological approach (1979), is the epistemic claim that the world can be perceived *directly*, without recourse to mediation by any hidden mental structures such as the representations or schema of the mind. Such a departure from the received view is plausible in light of another seemingly radical claim of Gibson's, namely that information about the world acquired by the individual is inherently meaningful. The traditional information processing view posited a physical account of the stimuli available for perception, and describes the various forms of energy available to the senses in the metrics of physics (e.g. the amplitude and frequency of sound waves, intensity and wavelength of light waves, the distance and size of objects etc.). Gibson rejected this reductionist view, along with the use of the term stimuli and the stimulus-response framework[17] (Gibson, 1979; Reed, 1988), suggesting instead that for psychology a description of the world in psychological terms was warranted (Michaels & Carello, 1981). This was not a rejection of physical science per se, since ecological psychologists remain theoretically consistent with the laws of natural science and place psychological activity firmly within the constraints of both biology and more widely physics. The significant point of departure from traditional theorists however, is the claim that the appropriate level of explanation for psychology was the level at which the individual engages with the environment, that is, the ecological level.

Thus, information, according to a Gibsonian ecological approach is considered to be the structures or patterns of energy that specify an environment, including the objects, places, and events of an environment, to an individual (Gibson, 1979). Gibson emphasised that this was not a definition of information as would be found in a dictionary in that ecological information is not communicated or transmitted to a receiver, rather it is simply available in the environment to be detected. Hence, if information about the environment is available in the environment, then the acquisition of this information requires no form of mediation, construction, or representation. Instead, it can be *directly perceived*, no elaboration over and above acquiring the information available is required to apprehend meaning.

[17] Consistent with the Gibsonian ecological approach to psychology, these terms are not used in the present research in the traditional, information processing sense.

To further elucidate Gibson's conceptualisation of ecological information, consideration must be given to the notion of *invariants*, that is, patterns of information "over time and/or space that are left unchanged by certain transformations" (Michaels & Carello, 1981, p. 20). These patterns are intrinsic to the energy fields (e.g. light, sound, heat etc.) that surround the individual, or what Gibson (1966) referred to as the *ambient array*, and are lawfully and uniquely constrained by their various sources in the environment. The structure of the light surrounding an individual (i.e. the optic array[18]), for example, is determined by the surfaces off which that light is reflected. The particular nature of these surfaces yields patterns of light specific to that surface. The light reflected by a banana differs from that reflected by a bowling ball in a lawful and predictable manner so that for each object there is an isometric correspondence between characteristics of the object (e.g. surface composition, size, shape etc.) and the structure within the light reflected by that object. It is the lawful specificity of this structure that carries meaning for the perceiver. Of course, different bananas structure light differently according to the characteristics of each individual piece of fruit (e.g. size, shape, ripeness). However, common elements in the structure of the light reflected by bananas persist regardless of the nature of the differences in structure among individual bananas. Thus, each banana is part of a larger equivalence class determined by the *structural invariants* within the light modulated by bananas. There exists an invariant structure in the optic array specifying bananas, or, for that matter, any object that is available for perception. This invariant structure is shared by all objects that at some level of description can be considered the same (Michaels & Carello).

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[18] Although the notion of invariants applies equally to any information in the ambient array, for simplicity the present discussion will be limited to that in the optic array.

The notion of invariants also has important implications for the perception of events. As objects or collections of objects change over the temporal course of an event, certain properties of the objects are preserved while others change. It is the style of change, or the *transformational invariants*, that are preserved and therefore available as information in the ambient array. To illustrate, evidence for transformational invariants within the patterns of human movement has been provided by Johansson (1973) who used the point-light technique, whereby reflective patches or lights are attached to the major joints (i.e. ankle, knee, hip, elbow, shoulder and wrist) and individuals are filmed so that only the lights are visible. Johansson reported that observers saw a random pattern of lights when the target was stationary, but observed a human form once the target began to move. Something specific to the movement of the lights allowed perceivers to know that they were viewing a human. Indeed, in a point-light display, the nature by which the lights move relative to each other in time and space is invariant by virtue of the biological constraints underlying the movement. The composition of the human body provides some constraint to movement in that there is a regular and lawful manner to which human movement conforms. For example flexion of the arm at the elbow has a range of approximately 180° and necessarily results in movement of the wrist along a regular arc, the radius of which is determined by forearm length. Given that observers were unable to identify the patterns of lights when the target was stationary, but were able to when movement was introduced suggests that it is the movement itself that specified meaning. The transformation or style of change of the pattern of lights, rather than the pattern itself, provided invariant structure, and hence specification of the event in the optic array. Michaels and Carello (1981) contrast the role of transformational and structural invariants in the provision of information in the ambient array suggesting that "if an event is something happening to something, the 'something happening' is presumed to be specified by transformational invariants while the 'something' that it is happening to is presumed to be described by structural invariants." (p. 26).

Extending the concept of invariants to consider all the surfaces and events of an environment, there is a global structure in the ambient array that specifies precisely that environment along with the contents and events of that environment to a perceiver. Obviously, the perceiver cannot apprehend all of this information simultaneously, so they must continuously sample the global structure by active exploration (e.g. shifting gaze direction, turning their head, looking or moving around). However, although some elements of the global structure remain constant (i.e. the invariants), the overlapping samples are not identical. The nature of this change may also be considered invariant in terms of the relationship between the actions of the perceiver and the environment. Moving to the left of an object always means that object is now to the right of the perceiver. Sampling the ambient array provides the perceiver with information not only about the environment, but also about their location in, and movement around, that environment (Michaels & Carello, 1981). Thus,

> according to the theory being proposed, *perceiving*, is the registering of certain definite dimensions of invariance...together with definite parameters of disturbance. The invariants are the invariants of structure, and the disturbances are disturbances of structure....The invariants specify the persistence of the environment and oneself. The disturbances specify the changes in the environment and oneself. (Gibson, 1979, p. 249, italics original).

However, even when one considers the environment to be information rich, therefore obviating the necessity for the individual to prescribe meaning to their world, only half of the story is being told. In addition to describing the information in the environment, the nature of the animal perceiving the information must also be considered. Not all invariant structures within the ambient array have significance to all animals. Some animals cannot detect some forms of information (e.g. bees are sensitive to the ultraviolet light reflected by some flowers but humans are not), hence it makes little sense to regard information simply as a property of the world without considering the properties of the organism that detects such information. Thus, Michaels and Carello (1981) suggest that information must be considered in terms of both what it is *about* (i.e. the environmental properties) and what it is *for* (i.e. the animal). The structure in an array of ultraviolet light reflected by flowers is informative *about* the location of pollen *for* pollinating insects. Information, therefore, cannot be described ecologically without reference to both the animal and its environment. In this sense, ecological information 'points both ways', implicating both the perceiver and that which is perceived in an animal-environment system (Turvey & Shaw, 1979). One cannot be studied without recourse to the other. Hence, the unit of analysis for the study of psychology from the ecological perspective must be the animal-environment system.

Defining the domain of study for psychology as the animal-environment system is still however, short of a full and complete description of psychological activity. Given the environment contains meaningful information to which the perceiver has direct access, it is reasonable to question the course by which an animal detects only information that has contextual significance to it, from amongst the virtually infinite variety of potentially available information. As discussed above, not all animals exploit all available information, that is, not all animals are attuned to all invariant structures. What animals then, are attuned to what information? To address this question, Gibson (1966; 1979) proposed what was possibly the most radical element of his ecological view of psychology, specifically, the concept of *affordances*. A description of affordances and the theoretical basis for the direct perception of affordances follows.

Affordances.

To be adaptive, an animal needs to engage with certain benevolent aspects of their environment and avoid potentially harmful aspects. The initial step in achieving such goals is to know about both the 'good' and the 'bad' aspects of the environment. This may be achieved by detecting the structured information in the ambient array which, as described above, allows meaning to be directly perceived. General detection of information in the environment alone is not sufficient to support adaptive functioning by an animal. Although there is invariant information specifying, for instance, bananas, this may well simply be incidental to the perceiver if the banana is not perceived as an edible, nutrition providing object. In addition to the detection of information, the animal must know what the information means to them, or as coined by Gibson (1979), what the *affordances* of their environment are. For Gibson, a description of the affordances of an environment involves describing what that environment "*offers* the animal, what it *provides* or *furnishes*, either for good or ill." (p. 127, italics original). In other words, an affordance is an opportunity within the environment for an individual to act or interact relative to the objects, places and events of that environment.

To illustrate, an affordance of a chair is that it provides one with a place to sit if so motivated. Similarly, a rock ledge, a tree stump or even a table may also offer the individual an opportunity to sit. However, affordances are more complex than merely static qualities of the environment. The same chair that was sat upon by an individual also offers them something to stand on if extra height is required or it may serve as a shield to avoid being injured if taming a lion. Furthermore, a child's high-chair will not provide a seat for an adult, nor will a bar stool to a newborn. The chair is able to be sat (or stood) on only because an individual is suitably equipped to sit (or stand) and the chair is able to withstand sitting (or standing) on by that individual without breaking. An affinity must hold between the properties of the environment and the potential actions of the perceiver for it to be possible for an affordance to be realised. Shaw, Turvey and Mace (1982) formalised this relationship as follows, "a situation or event X affords action Y for animal Z on occasion O if certain relevant mutual compatibility relations between X and Z obtain" (p. 196). Gibson highlighted this point, explaining that affordances cannot be measured solely in the metrics of physics, but "have to be measured relative to the individual" (p.127), thereby further reinforcing the position of the animal-environment system as the proper unit of analysis for ecological psychology.

Importantly, the fact that affordances exist and can be realised rests on the historical compatibility between the individual and their environment. Animate life has evolved within a relatively invariant environment (Gibson, 1979) such that certain adaptive propensities have been selected for which allow the organism to succeed within that environment. There exists a mutual reciprocity between the characteristics of the environment and the characteristics of the animal required for coping with this environment. As outlined above, Gibson has described the environmental characteristics as the affordances of the environment. Taken together, the set of affordances available to a particular animal can be thought of as the *niche* of that animal, a term borrowed from ecology (e.g. Elton, 1927) to refer to the functional role of an animal within an ecosystem, or as Gibson (1979) suggested, "*how* an animal lives [rather] than…*where* it lives" (p. 128, italics original). Therefore, an animal must have a set of abilities compatible with the niche which they occupy in order for both to coexist (Michaels & Carello, 1981). Such abilities or ways of being effective, have been described as *effectivities* (Shaw & McIntyre, 1974). Effectivities are the capabilities for action that a particular animal has with reference to a particular opportunity (or set of opportunities) for acting. Shaw, Turvey and Mace (1982) formalised the description of an effectivity as follows, "an animal Z can effect action Y on environmental situation or event X on occasion O if certain relevant mutual compatibilities between X and Z obtain" (p. 197). Thus, effectivity and affordance properties are seen as the complementary, co-implicative components of the relationship between the animal and its environment. To claim, for example, that a banana provides nutrition to a particular animal is to claim that the animal which obtains nutrition from a banana has effectivities specific to the properties of the banana. That is, the 'banana-eater' must be sensitive to information in the ambient array specifying bananas (e.g. bananas are visible to animals sensitive to the optic array), be able to grasp the banana (e.g. bananas are graspable to animals with appendages that can grasp) in order to pick it from the tree (e.g. bananas are pickable to animals with appendages that grasp and which have sufficient strength to pick), and be able to digest the banana to obtain the nutritional benefits (e.g. bananas are digestable for animals with an appropriate digestive system). Hence, effectivities and affordances are symmetrical to the extent that each must be reciprocal to the other for the animal and its niche to coexist (Michaels & Carello).[19]

Given that the environment contains a multitude of affordances, it is reasonable to question the nature of the selection of some affordances over others. Clearly no individual can realise the virtually infinite number of affordances in their environment, nor should they need to. Instead, the affordances that meet the goals and intentions of the individual are those which are searched for and acted upon. To return to an example provided above, a chair provides a place to sit for a weary individual, as well as something to stand on for someone wishing to retrieve something from a high shelf. Perceiving the affordances of a chair is not to know that an object is *called* a chair (even if one knows what chairs are for), but to know what one can *do* with the chair. That is, what the chair means to the perceiver. In this sense, the detection of an affordance is the detection of the *meaning* (Michaels & Carello, 1981) or *value* (Gibson, 1979) of the objects, substances, places, and events of the environment relative to the goals, intentions, and effectivities of the individual. Although there must be information available that specifies an affordance for a suitably attuned perceiver to detect, it is the meaningful opportunities for behaviour for an individual, that is the affordances, that Gibson described as the functional referent of perception.

[19] There is a controversy here in that the concept of effectivities may be viewed as redundant (Cutting, 1982). Gibson's notion of an affordance 'pointing both ways' takes account of both the properties of the environment and the properties of the animal simultaneously. However, for the researcher attempting to uncover such relationships between an individual and their environment, there is often utility in knowing the abilities and capacities of the individual relative to the characteristics of the environment in order to inform coherent theorising regarding a specific animal-environment interaction. For example, there is little point in investigating the role of the magnetic poles for human navigation given that humans are not sensitive to magnetic fields (cf pigeons and many other migratory animals). In this sense, describing the properties of the animal (i.e. effectivities) together with the properties of the environment (i.e. affordances) is potentially a necessary initial step toward explicating a genuinely monistic affordance relationship whereby both sets of properties are considered simultaneously. An important point to make here however is that affordances, when described as properties of an environment distinct from the effectivities of the individual, are essentially only *potential* affordances that are able to be realised by a suitably effective individual, but may not necessarily be acted on.

The perceiver does not simply register information, but actively detects relevant affordances. The name of an object or event, or knowledge of a category or class to which it may belong is arbitrary; it is the functional significance of the object or event that is perceived. As described by Gibson, "the special combination of qualities into which an object can be analysed is not normally noticed...If you know what can be done with an...object, what it can be used for, you can call it what you please" (p. 134). This point is further illustrated when the intentions and goals of an individual are considered. The same individual can use a chair in many different ways depending on their motivation. Again, it is not the fact that the object is called a chair that makes it useful, but that it provides a variety of opportunities for acting depending on the goals and requirements of the user.

It is important to note that this is not to suggest that affordances are simply subjective extensions of an individual's phenomenological experiences, nor that affordances are concrete objective properties of the environment. In fact Gibson (1979) rejected the distinction between 'subjective' and 'objective' as it applied to psychology, placing affordances firmly in the domain of the relational animal-environment system whereby such opportunities are "equally a fact of the environment and a fact of behaviour" (p.129). As facts of the environment, affordances are real. Even if they are not realised, affordances are not mere possibilities for behaviour (Reed, 1988). A chair is a real object that provides a range of affordances (sitting on, standing on etc.) regardless of whether anyone is actually sitting or standing on it. Clearly then, affordances must exist outside of the subjective domain. However, as facts of behaviour, affordances "are not specifiable independent of an individual" (Heft, 1989, p.4). Thus affordances must also exist outside of the objective domain. Instead of conceptualising affordance in terms of a subjective-objective dichotomy, Gibson suggested that affordances be considered "as facts of the environment of all observers that can be used by particular observers" (Reed, 1988, p. 294).

An implication of the theory of affordances is that there must be some means by which the animal has knowledge of the relationship between its own effectivity properties and the affordance properties of the environment. Perception of this relationship must occur to enable the individual to know its effectivities in relation to its environment. Gibson (1966) suggested that any act of perception necessarily entails perception of the self in combination with perception of the environment. Therefore, for effective perception and action the animal requires two basic types of information: *exterospecific* information that specifies the environment (in relation to the animal), and *propriospecific* information that specifies the animal itself (in relation to the environment). Reed (1996) further explicated this distinction, describing exterospecific information as that which "remains invariant regardless of anything the animal does...meaning that it specifies a fact of the environment" and propriospecific information as "information that varies in specific ways as a function of what the animal is currently doing...meaning that it specifies how an animal is encountering its environment" (p. 49). In the sense that exterospecific information must always coexist with propriospecific information, Lee (1978; 1980) has consolidated this notion of dual information into a singular concept, that of *expropriospecific* information, or information that specifies, in a relational manner the ongoing interaction between the individual and their environment. These formulations help overcome a further theoretical difficulty inherent within indirect theories of perception in that theories of mediated self-perception inevitably end up with either the same cognitive paradox as described earlier: knowledge of the self by means of mental representation requires knowledge of the self external to the representation; or the hypothesising of a distinct proprioceptive specific nervous system (Reed, 1988). By proposing that all perception of the environment is accompanied by perceptions of the self, ecological psychologists avoid the postulation of there being distinct forms or types of perception, and instead put forward that information about both the self and the world is simultaneously available for detection by the perceiver.

Finally, it should also be noted that reference to affordances is in terms of action, that is, an object or event affords acting upon (Michaels & Carello, 1981), or indeed has consequences for such action (or inaction). The function of perception, as suggested above, is not to know the environment, but to know what one *can do* in that environment. Seeing a rapidly approaching object is useful for avoiding, or catching that object, rather than simply knowing about the imminence of collision. The detection of affordances helps tailor or regulate the perceiver's actions relative to the opportunities for action present in the environment (Reed, 1996). Perception and action are therefore co-implicative in that the value of perception is in the manifestation of appropriate action, which in itself is constrained by, and dependent on, accurate perception. Therefore, perception and action, to ecological psychologists are in fact functionally inseparable, and are therefore frequently referred to in terms of a perception-action cycle.

In summary, proponents of Gibsonian ecological psychology argue that perception serves adaptive functioning in that perceiving entails the detection of the meaningful opportunities for an individual to act or interact that exist within their environment, a concept Gibson termed the 'affordances of the environment'. Furthermore, in contrast to the established, information processing accounts of perception and psychology more generally, Gibson proposed that the perception of affordances is direct, that is, not mediated by mental structures or representation. To support this view, the concept of information is reformulated to reflect lawful and specific invariant structures in the ambient energy array that surrounds the individual. For example, the structure of light reflected from the surface of an object has a lawfully isomorphic relationship to the nature of that object. In turn, the perceiver is attuned to detect such structure in terms of the affordances specified by this information. Thus, there is mutuality between the individual and their environment because affordances are properties of the environment taken with reference to the effectivities of the individual. The only way to satisfactorily understand the relationship between the individual and their environment, and in turn to understand psychology, is to consider each as an inseparable and reciprocal aspect of the other. Put briefly, we ought to consider human behaviour as arising from within a monistic animal-environment system.

An Ecological Approach to Social Psychology

In as much as Gibsonian ecological psychology represents a radical departure from the traditional cognitive constructivist account of psychology, this perspective also provides a fundamentally different approach to the study of psychological phenomena within social contexts. Contemporary social psychology is very much dominated by information processing theories of social behaviour as represented by the social cognitive framework being the standard theoretical approach in this field (Markus & Zajonc, 1985). For example, Kunda (1999), in an introduction to the area suggests that

> many of the central questions that social psychology has been concerned with from the earliest days – how we form impressions of others, how we explain their behaviour, how our attitudes relate to our actions, how we resolve conflicts among our beliefs, how our reactions can be tainted by prejudice – revolved around complex mental processes. (p. 2)

Similarly, in their overview of social cognition, Fiske and Taylor (1991) state that "social psychology has always been cognitive, in the broad sense of positing important steps that intervene between observable stimulus and observable response....Social cognition research attempts to measure the stages of social information processing" (pp. 14-16). Social cognition makes use of the basic premises of cognitivism, in that the mental structures and representations of the mind are said to mediate between the individual and the external world, in this case the social world. For many social psychologists, schema have become the central unit by which meaning is imposed on the apparently relatively meaningless world (McArthur & Baron, 1983), such that inherent to social cognition is an "unabashed commitment to mentalism" (Fiske & Taylor, p. 14).

Alternatively, as discussed above, the ecological approach to psychology explicitly rejects mentalism and indeed repudiates the very notion of indirect perception that this dualistic assumption entails. Instead, proponents of ecological psychology propose that meaningful information exists in the environment which therefore is available to be perceived directly without mediation from any intervening mental structures or processing. What is meaningful to the ecological psychologist is the affordances of the environment, the opportunities to act or interact. These principles apply not only to the perception of the inanimate objects, places, and events of the environment, but equally to the animate objects, the other animals and, in particular to the other people in the environment. This is to claim that what is perceived in regard to other people is not their qualities, nor their traits, identity, personality, character or any other category of psychological descriptors, but rather their affordances. The affordances of conspecifics, often referred to as *social* affordances, specify what can be done with, to, or by that person relative to the perceiver. These are the opportunities to act or interact relative to other people.

The claim that perceivers detect the affordances of others requires a shift in the conceptual and theoretical foundations underlying the field of social psychology (Knowles & Smith, 1982). As has been discussed in the preceding sections of this chapter, a commitment to the ecological approach requires a rejection of mind-body dualism and the associated notion of indirect perception. Instead, proponents of the ecological position posit a monistic animal-environment system whereby perception of ambient energy patterns specified by environmental properties is direct. Although the basic premise of the ecological approach, that is information specifying affordances is able to be directly acquired, has been well developed and described, initially by Gibson (1950; 1966; 1979) and subsequently by a number of other authors (e.g. Michaels & Carello, 1981; Reed, 1988, 1996; Shaw et al., 1982; Turvey & Shaw, 1979), relatively little application of the ecological approach has been seen within the domain of social psychology (Zebrowitz & Collins, 1997). Gibson (1979) provided a foundation for conceiving of the social world in an ecological sense, suggesting that the perception of social affordances

> is enormously complex, but it is nonetheless lawful, and it is based on the pickup of the information in touch, sound, odour, taste and ambient light. It is

> just as much based on...information as is the simpler perception of the support that is offered by the ground under one's feet. For other animals and other persons can only give off information about themselves insofar as they are tangible, audible, odorous, testable or visible. (p. 135)

Hence, to the Gibsonian ecological psychologist, social perception is simply a specific case of perception, albeit the perception of potentially highly complex objects and events. Such complexity is inherent to social perception in that the objects of perception, that is, the other people of the environment, are also animate and behave in complex ways. They are able to perceive and act in the same manner as the observer. In short, they are able to interact, both with the observer and with one another.

To conceive of other people as ecological objects for perceiving is to claim that there is veridical information regarding the affordance properties of these individuals available for perception. That is, people structure the ambient array by the same principles (i.e. natural optical laws) as inanimate objects. In this sense, Berry and Misovich (1994) suggest that "just as the appearance and movement patterns of *objects* are constrained by their internal properties, the structural and dynamic characteristics of *people* are lawfully related to their dispositional qualities" (p. 139, italics original). Thus, to consider social perception from an ecological perspective is to suggest that dispositions are in some way lawfully linked to occurrent properties, which in turn systematically modulate the ambient array such that information specifying disposition is available for perception (Baron & Misovich, 1993). What is perceived is the nature of these dispositional properties relative to the effectivities of the perceiver, that is, the social affordances of the environment. Thus, the epistemological position of the Gibsonian approach to social perception is that the affordance properties of individuals systematically constrain the ambient array such that information about others can be directly perceived (Baron & Boudreau, 1987; Knowles & Smith, 1982).

The extension of the premise of direct perception into the realm of social perception raises an important ontological question, namely: what is the basis of the invariant structure that specifies social affordances? How is it that the dispositions of people can lawfully constrain the ambient array? The path between the dispositional properties of inanimate objects and the specification of the affordances of these objects has been described above in terms of structural and transformational invariants. However, given the additional complexity social affordances entail, the path between the dispositional properties of the animate individual and structure within the ambient array may not be as clear. In suggesting that "the other person…is an ecological object with a…surface that reflects light, and the information to specify what he or she is, invites, promises, threatens, or does can be found in the light", Gibson (1979, pp. 135-136) maintained that the same principles applied to the specification of the affordances of both animate and inanimate objects. Obvious parallels exist at the level of structural invariants in that the isometric correspondence between the characteristics of any object (e.g. a banana or a person) and the modulation of the ambient array by these characteristics potentially specifies information about the nature of that object to a perceiver. The attuned perceiver is able to acquire and use this information to know about the affordances of that object. For instance, the ripeness of a banana specifies its edibility, or the identity of an individual (e.g. acquaintance versus stranger) specifies how one should interact with them (e.g. informal versus formal conversation). In each case the invariant structure of each object specifies what it is, or more correctly what it offers, in relation to a perceiver. On the other hand, the role of transformational invariants in the seemingly ever-changing context of social interaction may not be as intuitive. What meaningful information persists despite the apparent multitude of dynamic changes inherent to the complexity and subtlety of two or more interacting individuals?

To illustrate the role of transformation invariants in the specification of social affordances two relevant empirical demonstrations will be reviewed. The first of these concerns a program of research conducted by Shaw and colleagues (e.g. Pittenger & Shaw, 1975a, 1975b; Pittenger, Shaw, & Mark, 1979; Shaw, McIntyre, & Mace, 1974; Shaw & Pittenger, 1977; Todd, Mark, Shaw, & Pittenger, 1980) to investigate the nature of the information that specifies human growth and aging. The age of an interaction partner is very pertinent to the opportunities to interact with that person (i.e. a baby, an infant, an adolescent and an adult all require quite distinct types of interaction) and therefore needs to be perceived for the interaction to be appropriate and successful. To this end, aging can be considered as an event, albeit a very gradual event, that results in the transformation of certain properties of the individual while preserving others. Individuals clearly change in facial appearance from infancy to adulthood, yet most often they are still easily recognisable as the same person. In particular, craniofacial morphology changes from a relatively circular head at birth, to a more elongated shape at maturity. These changes are due to the physical and biological constraints present during growth. Specifically, "the direction of growth along which the skull shape is strained follows lines of least resistance against such factors as muscle, cartilage, fluid pressure, gravitational attraction, atmospheric pressure and growth of the brain" (Michaels & Carello, 1981, pp. 128-129). The morphological effects of growth can be accurately characterised in terms of a geometric transformation, specifically the cardioidal strain.[20] If this transformation is applied to the outline shape of an infant skull, the resulting shape conforms to that expected with normal growth. This growth pattern pertains, for instance, when x-rays of an individual's skull at different ages are compared. If the cardioidal strain is applied to the outline of the skull as it appears in the earlier of the two x-rays, the resulting image is almost identical to the outline in the second x-ray (Todd et al., 1980). In turn this information (i.e. the shape of the skull) can be used by perceivers to accurately predict age (Pittenger & Shaw, 1975a). In fact, Pittenger and Shaw (1975b) reported that 96% of the variance in participant's judgements of the age of a series of computer-generated facial profiles could be accounted for by the degree of cardioidal strain that had been applied to a standard profile. Similar results have been found when the cardioidal strain has been applied to cartoon drawings of the 'faces' of birds, monkeys, dogs and even Volkswagen 'beetle' cars (Pittenger et al., 1979). Importantly, not only can perceivers determine age from the degree of cardioidal transformation a given skull has undergone, but this information also specifies age-related social affordances, including, for example, whether an individual requires nurturing and care, or whether there is biological potential for procreation. Thus, biological and physical factors are seen to lawfully constrain the nature of the transformation of craniofacial morphology associated with growth and aging such that there is invariant information which allows a perceiver to know the age and therefore information about the social affordances of an individual.

[20] Cardioid is the geometrical term that refers to a heart-shaped figure with a rounded tip. Cardioidal strain is the geometric transformation that follows this general pattern in that 'growth' is symmetrical around a nodal point.

A second illustration of transformational invariants providing an informational basis for social perception rests on Runeson and Frykholm's (1983; 1986) principle of the *kinematic specification of dynamics* (KSD). This principle extends on the work of Johansson (1973), which, as described earlier suggested that the anatomical and biomechanical constraints on human movement specify an invariant pattern of information specific to human movement. The KSD principle explicitly distinguishes *kinematics*, that is, motion described in terms of movement properties (e.g. velocity, acceleration, direction) from *dynamics*, that is motion described in terms of causal and constraining properties (e.g. mass, force, biomechanics, intentions, emotions). The perception of events is considered to be based on the dynamic rather than kinematic properties of the world to the extent that the kinematics are constrained by the dynamics. In other words, "we tend to perceive causal aspects of events, not movements as such" (Runeson & Frykholm, 1983, p. 588), because "*movements specify their cause*" (Runeson & Frykholm, 1986, p. 262), italics added). Expressed more formally, the KSD principle states that if a dynamic factor *a* influences the kinematic shape of movement *M*, then the kinematics of *M* specify *a* (Runeson & Frykholm, 1983). Human movement (or movement of any animate object for that matter) is a lawful occurrence in that it is subject to extensive constraints with respect to the anatomical make-up of the individual (e.g. biomechanical factors) and the mechanical forces of the environment (e.g. laws of motion). The size and shape of bones, the elasticity and dampening properties of soft tissue, the distribution of mass over the body as a whole, as well as the natural laws (e.g. gravity), taken together govern what is and is not possible movement. The underlying assumption of the KSD principle is that the effect of these factors on movement is revealed in the kinematic pattern produced by that movement. Thus, kinematics are constrained by, and therefore, *specify* dynamics.

Evidence in support of the KSD principle has largely been derived from studies employing Johansson's (1973) point-light technique. This methodology is useful for evaluating the KSD principle as the display of an event is limited to almost entirely kinematic information. In this manner, by varying the underlying constraints (i.e. the dynamic properties of the event in question) any systematic effects on kinematics can be observed. Furthermore, by having perceivers evaluate relevant dimensions of the display (e.g. make judgments about what is happening) the utility of kinematic information as a specification of the dynamic properties of an event can be determined. For example, the typical anatomical make-up of males and females differs along a number of dimensions (e.g. shoulder width, hip width, distribution of mass) such that, according to the KSD principle, these structural differences are manifest in kinematic properties. Indeed, a number of studies have revealed that perceivers can accurately identify the sex of most individuals when they are walking from kinematic information (e.g. point-light displays) alone (e.g. Barclay, Cutting, & Kozlowski, 1978; Kozlowski & Cutting, 1977; Runeson & Frykholm, 1983, 1986). Similar results have been obtained in terms of the specification of an individual's identity (Cutting & Kozlowski, 1977) whereby each individual presumably has a unique composition of anatomical and biomechanical properties that uniquely structure the kinematic pattern obtained when they walk.[21]

[21] Runeson and Frykholm (1983) describe this as a *kinematic fingerprint*.

Of particular interest for social perception is the application of the KSD principle to deceptive actions. In this regard, the KSD principle predicts that deceptive actions will not precisely simulate the kinematic nature of the actual action as the underlying dynamic factors are different in each case. The nature of the dynamic factors underlying movement (e.g. anatomical proportions, laws of mechanics etc) cannot be manipulated with sufficient precision (Runeson & Frykholm, 1986). Hence when attempting to simulate kinematic information (i.e. attempting to deceive), factors in addition to the dynamics constraining the equivalent non-deceptive action are also specified kinematically. Thus, Runeson and Frykholm (1986) suggest that deceptive action can "at best, recreate *some* kinematic details, but there will be other aspects of the kinematic pattern that are altered in an inappropriate manner" (p. 262, italics original). Furthermore, they suggest "the execution of genuinely deceptive movements would entail producing kinematic patterns that specify a model set of dynamic conditions, which does not in fact obtain (e.g. a different anatomical make-up or a different action)" (Runeson & Frykholm, 1983, p. 593). In support of this claim, these authors demonstrated that when actors attempt to fake their movements to appear as a member of the opposite sex, observers could accurately determine the actual sex of the actor from kinematic information only. Comparable results have also been obtained whereby perceivers could determine from kinematic patterns whether an actor was actually lifting a heavy box, or simulating such an act with a relatively light box (Runeson & Frykholm, 1983). More recently Richardson and Johnston (2005) reported that the identity of young men can be accurately determined from kinematic information only, even when the young men were attempting to disguise their identity by attempting to "impersonate a 70 year-old man" (p. 31).

These examples highlight an important aspect of the KSD principle for social perception in that the dynamics that structure kinematic patterns include not only mechanical properties, but also the dispositional properties of the individual. Emotions, intentions and expectations as well as anatomy, biomechanics and physics are all considered to be dynamical properties that lawfully constrain kinematic information (Runeson & Frykholm, 1983). Perceivers are able to use kinematic information to determine the expectations of an actor in regard to the weight of a box they are about to lift. The preparatory actions (e.g. posture, stance, bending etc) for lifting a box of a certain weight are specified kinematically (Runeson & Frykholm). Furthermore, of particular relevance to the present research, Bassili (1978; 1979) reports that the kinematic patterns of facial expressions of emotion are able to be used by perceivers to discriminate between different emotions.[22] Indeed, the notion that emotional experience influences movement patterns has been discussed by Koffka (1935) who suggested that

> The slow dragging movements of the depressed, the jerky discontinuous movements of the irritable, correspond, indeed to the leaden state of depression or the disrupted state of irritability...and will provide proximal stimuli for other persons who observe....If an emotional stress steers action, then the ensuing movements will, to some extent, mirror the emotions; characteristics of overt behaviour will map characteristics of the field in which this behaviour is started. (p. 658)

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[22] These results should be interpreted with caution as Bassili used actors to simulate emotional expressions. In the context of the current research, and the predictions derived from the KSD principle pertaining to simulated action (see above) reservations regarding the ecological validity of this approach need to be addressed before these conclusions can be accepted without question (see Chapter 3 for a discussion of the requirements for the development of ecologically valid facial displays for use in research).

Aronoff, Woike and Hyman (1992) demonstrated that the geometrical configurations inherent to particular facial expressions of emotion (specifically the 'angularity and diagonality' of an expression of anger, and the 'roundedness' of an expression of happiness, Aronoff, Barclay, & Stevenson, 1988), when present in the movement patterns of dancers portraying various characters from classical ballets, were perceived in a manner consistent with the original expression. Diagonal and angular kinematic patterns were perceived as threatening, while more rounded movements were perceived as conveying warmth. Similar results were obtained when these geometric patterns were represented as simple line drawings. Although further investigation is required in this area, it is contended that the characteristics of a given emotion, as a multi-componential mode of interaction (see Chapter 1), lawfully constrain the movement patterns of an individual experiencing that emotion. In this manner, disposition can, by means of constraining the available (kinematic) information, be directly perceived.

Thus, consistent with the Gibsonian account of the direct perception of the affordances of inanimate objects, structural and transformational invariants pertaining to animate objects, that is the other people and other animals of the environment, have been shown to modulate the ambient array in a systematic manner. Information specifying the socially relevant dispositional properties of others is therefore seen to be available for perception in terms of the social affordances of these individuals. Accordingly, the epistemic claim of the ecological approach to social perception, specifically that the affordance properties of individuals can be directly perceived, appears to have a sound ontological basis. Dispositions, including intentions, expectations, and emotions, can be lawfully linked to occurrent properties in the environment. As a result, invariant information is available that allows the perceiver to know the opportunities for action and interaction relative to the other people in their environment.

In addition, in keeping with the conceptualisation of affordances in general, the perception of social affordances is similarly dependent on the properties of the environment (i.e. the dispositional properties of other individuals) in *relation* to the effectivities of the perceiver. That is, social affordances can be realised only in the conjoint activities of the perceiver and the subject of perception, in this case conspecifics (Baron & Misovich, 1993). Baron and Boudreau (1987) emphasised this point, suggesting, for example, that the perception of an opportunity to cooperate[23]

> truly only exists in the reciprocal, coordinated action of two or more individuals, that is, cooperative action involves two or more people engaged in actions that are mutually facilitative in the sense that there is joint movement toward a common goal (p. 1223).

Hence, reciprocity must exist between the affordance properties of the social environment and the effectivities of the perceiver in order for the invariant information specifying disposition to be of utility in guiding social behaviour. To illustrate, in regard to sexual reproduction what males afford females is reciprocal to what females afford males (Gibson, 1979). Again, as indicated above, the required symmetry between effectivities and affordances, in this case as they pertain to social interaction, emphasises the importance of defining the unit of analysis for psychology as the monistic relationship between the individual and their environment. Considering either component to be in any way functionally separable from the other

[23] That is, the perception of the affordance of cooperability.

immediately undermines the theoretical coherency gained by adopting an ecological approach to psychology. Gibson in fact intimated the significance of defining the discipline monistically when he suggested that "behaviour affords behaviour, and the whole subject matter of psychology and of the social sciences can be thought of as an elaboration of this basic fact" (p. 135).

Posed and genuine smiles considered from the ecological perspective.

At this point it is necessary to consider the suitability of the Gibsonian ecological approach to psychology as a theoretical framework for the present research. As outlined in the previous chapter, the general aim of this thesis is to provide an investigation of the function of posed and genuine smiles in social interaction. To this end, an assessment of the nature of the sensitivity of perceivers to the information that distinguishes posed from genuine smiles is the central focus of the strategy adopted for the empirical components of this work. This approach falls within the domain of social perception, a field that although dominated by the information processing approach to psychology, shows clear amenability to the ecological approach in that knowledge about others is considered to be perceptually based (McArthur & Baron, 1983; Zebrowitz, 1990). Thus, at this stage two general questions need to be considered in regard to the applicability of the Gibsonian framework to the present research: 1. Does discriminating between posed and genuine smiles offer the perceiver any functional advantage? 2. If so, what information is available that specifies this difference?

The first question derives from Gibson's basic dictum that "perceiving is for doing", that is, perception serves adaptive function. As discussed in Chapter 1, contemporary theorists of emotion have variously considered emotions to be multi-componential, biologically based patterns of action and interaction that, as a result of natural selection, serve specific ecological functions. Fridja (1986), for example, refers to emotional responses as changes in action readiness, that is modes of relating to or interacting with the environment. In a similar vein, McArthur and Baron (1983) suggested that from a Gibsonian perspective, emotions may best be considered "as a guide to action" (p.226). Lazarus (1991) commented similarly, suggesting that "an emotion may…be informative to the person who experiences it…as a source of insight into oneself and what is happening" (p. 18). In short, the various emotional states equip the individual to be able to deal more effectively with the contingencies of a given situation (e.g. the increase in physiological arousal accompanying anger is helpful for fighting), that is, to regulate their interaction with the environment. Consequently, for a perceiver there may be considerable advantage in knowing the emotional state of interaction partners as a means of knowing their dispositional properties, and therefore the relevant opportunities for interaction with these individuals. In short, the perception of emotional state equates to the perception of social affordances. For instance, presuming that one wishes to avoid harm, there are distinctly different opportunities for interaction with an angry person than with a happy person. McArthur and Baron expressed this claim when they suggested that emotions can be considered as information about "social affordances in the sense that they call forth various interpersonal behaviours. For example, anger is likely to provoke avoidance, whereas joy is likely to encourage approach" (p.226). Thus, following this rationale directly, it is argued that there is considerable adaptive advantage for a perceiver to be able to perceive whether or not another individual who is smiling is happy, that is to be able to discriminate between posed and genuine smiles. Genuine smiles specify the social affordances of an individual experiencing a positive emotional state. For instance, Owren and Bachorowski (2001) suggest that an individual exhibiting a genuine smile is somebody who affords cooperating with, that is, they are *cooperable* with. Posed smiles on the other hand, are unrelated to emotional experience, and therefore specify a distinct set of affordance properties. The affordances specified by posed smiles are likely to relate directly to the intentions of the smiling individual, ranging for instance from smiles intended as nonverbal greetings to smiles intended to deceive. An intention to deceive may involve attempting to have interaction partners erroneously believe you are experiencing positive emotion, or in other words, believe that you possess the affordances of a happy individual when you do not. Regardless however, of the motives of the person posing a smile, their dispositional properties, and therefore affordances, are categorically different compared to when the same individual is genuinely smiling. Hence, in the sense that there is clear functional advantage in the accurate detection of emotional state in others, perceivers need to be able to distinguish between posed and genuine smiles in order to interact adaptively. A failure to do so may result in the misperception of the social affordances of interaction partners, and, as a consequence, lead to interaction inappropriate to these affordances. For instance, according to Owren and Bachorowski's recent theory of the evolutionary function of posed and genuine smiles, if a posed smile is misperceived as a genuine expression of positive emotion, the perceiver runs the risk of attempting to cooperate with the smiling individual when cooperation is not appropriate, and therefore risks exploitation.

The second question addresses the informational basis by which the perceiver can distinguish between posed and genuine smiles. For the affordances of the smiling individual to be perceived, there must be information available that specifies the ontological basis of their expression. The claim of the present thesis is that the morphological distinctions between posed and genuine smiles (e.g. the Duchenne marker, symmetry, smoothness, duration and possibly synchrony, described in Chapter 1) structure the optic array in a manner consistent with the distinct dispositional properties underlying these expressions. This structure is the invariant information that specifies the ontology of any particular smile, and therefore specifies the social affordances related to the emotional state of the smiling individual. Thus, consistent with Runeson and Frykholm's (1983; 1986) KSD principle, it is suggested that the dispositional properties underlying each type of smile (i.e. positive emotion versus intention to simulate positive emotion) constrain the morphological appearance of each expression. The dynamic properties underlying a genuine smile, that is, the multi-componential properties of a positive emotional experience, systematically constrain the contraction of the facial muscles resulting in the kinematic pattern typical of a genuine smile. A separate set of constraints,[24] unrelated to emotional experience, are responsible for the patterns of movement characteristic of a posed smile. The distinct neurological pathways that innervate spontaneous and volitional expressions respectively (see Chapter 1) not only result in some facial muscles (e.g. *orbicularis oculi pars lateralis*) being relatively less able to be wilfully contracted than others (Damasio, 1994), but also in different ballistic patterns of muscular contraction (e.g. smooth versus erratic contraction, facially symmetrical versus asymmetrical contraction) and differences in the variability of the duration of the expression (e.g. spontaneous expressions are less variable in duration than volitional

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[24] Or plausibly *sets of constraints* as posed smiles may reflect one or more of many different intentions.

expressions). Importantly, these differences are manifest in the kinematics[25] of the respective facial expressions, which in turn, provides invariant information for perception of the dispositional properties underlying each expression, that is, for the social affordances specified by posed and genuine smiles respectively.

Thus, there appears to be both an adaptive and an informational basis for the perceiver to know the underlying dispositional properties, and therefore, the relevant opportunities for interaction, in regard to an individual exhibiting a smile. In so far as emotions have adaptive function in terms of equipping the individual to cope with the demands of their environment, the detection of the emotional state of others offers similar advantage in that the perceiver is able to use this information to regulate and control social interaction. For this reason, it is advantageous for the perceiver to be able to distinguish between genuine smiles that have an ontological basis in emotional experience, and posed smiles that have no such underlying emotional quality, but instead are likely to reflect intent. Furthermore, it is suggested that the relative presence or absence of positive emotional state accompanying a smile lawfully constrains the kinematic pattern of that smile such that invariant information is available which specifies the ontology of any particular expression. Although the precise nature of this information has yet to be expressed mathematically (cf. the cardioidal strain as a description of the growth transformation), the physiognomy and ontology of posed and genuine smiles has been described in sufficient qualitative detail to allow precise verification of the morphology of these expressions for use in

[25] It is also important to note that the kinematic patterns specific to posed and genuine smiles respectively result in different changes in observable facial morphology (e.g. deformation or wrinkling of skin, movement of 'landmarks' such as eyebrows, mouth, eye aperture etc) such that some of the relevant information for detecting the dispositional properties (i.e. social affordances) specified by posed and genuine smiles is likely to also be available for perception in static photographs. See Chapter 3 for further elaboration of this point.

research (see Chapters 1 and 3 for further detail). Therefore, what remains is to assess the sensitivity of perceivers to the information that distinguishes genuine from simulated expression of positive emotional state, and in turn whether perceivers are attuned to the differential affordances of these expressions. This is the empirical focus of the present research.

CHAPTER 3

Generation of Facial Displays

In order to investigate the sensitivity of perceivers to the differences between posed and genuine smiles in an experimental setting, participants need to be exposed to examples of these facial expressions. Although this requirement is seemingly straightforward, the nature of the facial displays employed can have dramatic implications for the generalisability of results from the laboratory setting to real-world social interactions. In short, it is fundamental to research of this nature that the facial expressions employed adequately replicate the relevant information available to perceivers during actual social interactions (Alley, 1988a; Gibson, 1979; Motley & Camden, 1988). This chapter explores the requirements for ecologically valid posed and genuine smiles, reviews the approaches of previous research with regard to the production of these facial expressions, and details the procedure employed for the generation of posed and genuine smiles for the present research.

Requirements for Ecologically Valid Posed and Genuine Smile Displays

Emotion Distinction

The use of ecologically valid examples of posed and genuine smiles within an empirical context is critical to the generalisability of the research as a whole. By definition, a genuine smile is accompanied by a positive affective experience (e.g. happiness), while in comparison, a posed smile is not (Ekman, Davidson, & Friesen, 1990; Ekman, Friesen, & O'Sullivan, 1988; Frank, Ekman, & Friesen, 1993). It follows, therefore, that research examining the sensitivity of perceivers to the differences between posed and genuine smiles must employ ecologically valid examples of these expressions that adequately replicate the ontological distinctions between the smile types. In other words, smile type should be operationalised according to the emotional status of the expresser. In particular, genuine smiles must occur spontaneously and within the context of a positive emotional experience. Alternatively, posed smiles should be initiated under volitional control, preferably in the absence of any specific emotional state.[26]

Furthermore, the significance of valid operationalisation of posed and genuine smiles has particular pertinence to the ecological approach to social perception. In line with J. J. Gibson's dictum that *perceiving is for doing*, perceivers should be sensitive to the meaningful difference between posed and genuine smiles such that the relevant opportunities for interaction can be identified. What is meaningful to perceivers in this respect is the affective context within which another individual smiles; specifically, whether a smile occurs in the presence or absence of a positive emotional experience. It is this underlying emotional state that is meaningful with respect to social interaction, and which structures the information available to the perceiver. Thus, when generating posed and genuine smile displays, it is important to re-create the antecedent events (e.g. positive affect) that structure the information available for detection by the perceiver, rather than simply simulate this information in the absence of any underlying cause. Constructing genuine smiles in the absence of positive affect, while potentially offering a high degree of experimental control, provides no assurance that the structure present in the simulated expression corresponds sufficiently with that of an actual genuine smile, and therefore offers no guarantee that the information available to the perceiver accurately specifies any meaningful

[26] While posed smiles may, technically, occur in concert with any emotional state (with the exception of happiness), these emotions may also be expressed via the face and consequently confound the visual information specified by the posed smile with that of any other emotion being expressed.

difference in terms of the veracity of the expression (Alley, 1988a). A constructed or simulated genuine smile is, by definition, in fact a posed smile. Hence, the approach of simulating genuine smiles is equivalent to the construction of posed smiles, and therefore fails to adequately realise the ontological distinction between these expressions. As a consequence, ensuring that examples of genuine smiles are spontaneous expressions of positive affect, rather than simulations, will ensure that the information available to perceivers accurately reflects that present in the real-world reference situation (e.g. an actual social interaction) thereby enhancing the ecological validity of the experimental procedure.

Physiognomic Distinction

As reviewed in Chapter 1, posed and genuine smiles differ physiognomically in a number of ways. To reiterate, while all smiles involve contraction of the *zygomatic major* muscles, only spontaneous, genuine smiles recruit the *orbicularis oculi* muscles, which results in a wrinkling of the skin at the outer corners of the eyes (i.e. the Duchenne marker). Hence, a requirement for valid posed and genuine smile displays is to ensure these physiognomic indicators vary appropriately and systematically between smile types. Therefore, the experimenter needs to assess if the requisite muscles (i.e. *zygomatic major* and *orbicularis oculi*) are contracted within the context of any given facial expression. The most direct means to determine if, and when, facial muscles are recruited is facial electromyography (EMG). However, facial EMG involves attaching electrodes to the facial muscles of interest to record the electrical activity associated with muscle contraction. The electrodes are problematic for the individual displaying the expression as they have a number of wires extending from the electrodes attached to his/her face that create a somewhat unnatural situation, and for the perceiver, who must somehow look past this equipment to see the facial expressions of interest. Furthermore, the sensitivity of facial EMG measurement is such that muscular activity too slight to produce visible facial actions will readily be recorded (Cacioppo, Bush, & Tassinary, 1992). Obviously, only muscle contractions that produce visible, detectable deformations of facial tissue will provide information for the social perceiver. Hence, EMG measurement may be too sensitive when distinguishing between posed and genuine smiles for the purposes of the present investigation.

An alternative to facial EMG is to code visual changes in facial appearance. Ekman, Friesen and Hager's (2002) Facial Action Coding System (FACS) is a comprehensive anatomically based coding system for identifying all visually discernable facial movements. FACS classifies facial expressions into 46 unique action units (AUs) which, in being derived from facial musculature, correspond to each potential independent movement of the face. Criteria are also provided to score the intensity of each AU. FACS has been widely validated and is frequently used as a systematic means of identifying and describing facial movements (e.g. Keltner, 1997; Prkachin, 1997; Rosenberg & Ekman, 1997; Sayette, Cohn, Wertz, Perrott, & Parrott, 2001; Suzuki & Naitoh, 2003). In regard to the distinction between posed and genuine smiles, FACS AU6 and AU12 describe the visible movements associated with contraction of *orbicularis oculi* and *zygomatic major* respectively. In brief, AU6 (*orbicularis oculi* contraction) draws the skin from the temples and cheeks towards the eyes and raises the infra-orbital triangle resulting in a narrowing of the eye aperture and wrinkles extending radially from the outer corners of each eye. AU12 (*zygomatic major* contraction) is evidenced in terms of the corners of the lips being pulled back obliquely toward the cheekbone resulting in an upturned mouth characteristic of smiling (e.g. ∪), a deepening of the nasolabial furrow and at high intensities, bagging of the skin below the eyes. Full FACS criteria for assessing changes in facial appearance resulting from the contraction of these muscles can be seen in Appendix A. Examples of a posed smile and a genuine smile are displayed in Figure 1.

Individual Differences in Facial Configuration

In addition to ensuring posed and genuine smile displays differ according to the physiognomic and affective state of the expresser, additional qualities of the face known to influence person perception also need to be considered when constructing these materials. At the broadest level, it is well documented that individual differences in facial structure and appearance can influence social perception. For example, facial attractiveness has been shown to influence social interaction according to a 'what is beautiful is good' heuristic, commonly termed the Halo Effect (Zebrowitz, 1997). Facially attractive individuals tend to elicit more favourable evaluations and impressions from others, and in turn experience advantages across a range of social settings such as interpersonal relationships (Feingold, 1990; Walster, Aronson, Abrahams, & Rottmann, 1966), the courtroom (Stewart, 1980; Zebrowitz & McDonald, 1991), and politics (Lewis & Bierly, 1990; Sigelman, Thomas, Sigelman, & Ribich, 1986). Effects of facial appearance on person perception have also been reported in regard to perceived facial maturity (e.g. the 'baby face effect', Berry & McArthur, 1986; McCabe, 1984; Zebrowitz, Kendall-Tackett, & Fafel, 1991), facial anomalies (Shaw, 1988), and specific facial features (Blair, Judd, Sadler, & Jenkins, 2002; Livingston & Brewer, 2002). Of particular pertinence to the present research, Zebrowitz, Hall, Murphy and Rhodes (2002) reported that certain structural qualities of the face, such as attractiveness, symmetry, and eye size influence perceptions of honesty.

The requirement, therefore, for valid posed and genuine smile displays, is to ensure that the effects of facial configuration on person perception do not systematically bias perceptions of either posed or genuine smiles. Hence, effects of individual differences in facial structure need to be controlled if conclusions relevant only to the distinction between posed and genuine smiles are to be drawn. Experimental control may be attained by employing a sufficiently wide range of faces so that all relevant variations in facial structure are represented. However, the complexity of individual differences in facial structure and the related effects on person perception preclude this approach simply by virtue of pragmatics. Many thousands of individual faces would be required to ensure all dimensions of facial configuration are characterised, let alone all possible combinations of these features.[27]

An alternate approach to controlling the effects of facial appearance on social perception involves narrowing the range of morphological variation between faces by using composite or averaged faces. This is achieved by means of computerised morphing algorithms (e.g. Winmorph, Morph 2.4 etc) which mathematically combine images of individual faces into an interpolated hybrid face (e.g. Benson & Perrett, 1993; Langlois & Roggman, 1990; Steyvers, 1999). The resulting images are essentially blends or averages of the original images and therefore contain

[27] Valentine (1991) characterised variations in faces in terms of a 'face-space', an n-dimensional space in which each individual face represents a point along the dimensions that specify differences between faces (e.g. age, symmetry, width between eyes, hair colour etc.). This representation illustrates the vast array of configurations of facial features that would be required if all socially relevant aspects of variation in facial morphology were to be controlled for.

information relevant to the configural qualities of all the original faces, but specific to none. However, although routinely used as referents in face and emotion perception research (e.g. Harmer, Perrett, Cowen, & Goodwin, 2001; Rhodes, Halberstadt, & Brajkovich, 2001; Sato, Kochiyama, Yoshikawa, Naito, & Matsumura, 2004), morphed or composite faces are not real faces and therefore may not generalise well to an actual social interaction. By combining one or more faces into a single composite image, the patterns of relationships between the features specific to a particular face will be lost, and replaced by the emergent patterns of the novel, hybrid face. Further, Busey (1998) has shown that morphing faces systematically biases the resulting face in terms of perceived age, adiposity, density and typicality compared to the original, parent faces. Given the effects of facial appearance on person perception discussed above, it appears that the method of construction of composite faces, rather than the information supplied by the face, may have greater influence on the social perceiver. To this extent, while morphing may offer a means to reduce the influence of individual differences in facial configurations on person perception, the artificial nature of the morphed face, as well as the bias introduced by the morphing procedure, undermine the ecological validity, and hence suitability, of morphed faces as materials for the present research.

A third strategy for controlling the effects of individual differences in facial appearances is, in part, a compromise between (a) attempting to account for the range of facial variation by sampling many faces and (b) narrowing the variation between faces by using composite images. A basic requirement for posed and genuine smile displays is to ensure that *both* expressions are obtained from each individual face. As discussed, many factors are known to influence person perception, including factors related to facial appearance. By removing all variation in facial appearance other than that of interest, or more specifically, by comparing responses to the same individual exhibiting either a posed or genuine smile, valid conclusions relevant to the smile type can be drawn without introducing potential for extraneous variables associated with comparison between individual faces. In addition, to enable generalisation beyond interaction with a particular individual, multiple individual faces should be used. While it has been acknowledged that this is an impractical method of accounting for all spurious effects of facial appearance on person perception, the use of several different faces provides a means to compare the effects of posed and genuine smiles of different individuals. In turn this provides the researcher with the potential to draw conclusions more widely applicable to general social interaction than would be possible if only a single individual face was employed. Alternatively, if the effects of posed and genuine smiles are not consistent across individual faces, exploration of how the faces differ, may provide important clues about how these facial expressions interact with general facial morphology in regard to person perception. Thus, the approach adopted for the present research obtains a full complement of facial expressions (i.e. in this case neutral expressions, posed smiles, and genuine smiles) from a range of individuals.

Gaze Direction

It has been suggested that within social contexts the orientation of another person's attention can have important implications for social perception (e.g. Jenkins & Langton, 2003; Langton, 2000). Given that animals, humans included, tend to orient toward objects in the environment that are relevant to them, gaze direction appears to be a reasonable indicator of attention. In this sense, establishing eye contact with another person has particular social significance in that eye contact indicates that person is attending to you, which in turn, suggests that an interaction may be likely. Indeed, recent research has suggested that gaze direction (e.g. direct versus averted) has significant implications. Macrae, Hood, Milne, Rowe and Mason (2002) reported that aspects of person perception, specifically sex categorisation and stereotyping effects, were facilitated when the target's gaze is directed toward, compared with away from, the participant. Furthermore, Adams and Kleck (2003) recently demonstrated that in regard to person perception, gaze direction interacts with facial expressions of emotion. Of particular relevance to the present research, is the finding that expressions of happiness were more rapidly identified when displayed with a direct rather than with an averted gaze. These effects are in line with the ecological notion of social affordances in that attention from another person, specified in this instance by eye contact, suggests interaction is more likely than if gaze is averted. Taking these findings into consideration, it is necessary to ensure that all individuals are looking forward, directly into a camera (or other recording device) when generating posed and genuine smile displays.

Dynamic and Static Expressions

The ecological approach to perception asserts that information is best revealed in events; that is, in dynamic, often multimodal transformations of objects in the environment occurring over time (Gibson, 1979; McArthur & Baron, 1983; Michaels & Carello, 1981; Reed, 1996). In line with this proposition, transforming facial expressions of emotion ought to be more informative to perceivers than static representations of emotional facial expressions, since facial expressions are dynamic, temporally distributed occurrences. Indeed, several studies have demonstrated superior recognition of emotional state (Frijda, 1953; Harwood, Hall, & Shinkfield, 1999), age (Berry, 1990) and famous faces (Lander, Christie, & Bruce, 1999) from dynamic as compared to static presentation of faces. However, this is not to suggest that static representations of faces cannot be informative. A majority of the research concerning the detection of facial expressions of emotion has employed static photographs of faces and shown universal recognition rates substantially greater than chance (e.g. Ekman & Friesen, 1974; Frank & Stennett, 2001; Izard, 1994). In fact, many researchers have argued that very rapid detection of emotional state in conspecifics potentially offers substantial adaptive advantage (e.g. Dimberg, Thunberg, & Elmehed, 2000; Murphy & Zajonc, 1993; Stenberg, Wiking, & Dahl, 1998). Immediate knowledge of the emotional state of others is likely to be more useful for guiding interaction than having to wait for a facial expression to 'run its course'. In short, facial expressions occur over substantially longer periods than required for detection of an emotional state. While dynamic presentations of facial expressions offers superior levels of ecological validity,[28] for research concerned with the very rapid detection of emotional state, static photographs may indeed preserve a suitable degree of generalisability from the research context to the real-world where often only a glimpse of another person's face is required to know, accurately, the nature of their emotional state (Esteves & Ohman, 1993). A qualification of this approach is, however, that static facial photographs must be sourced from dynamic representations, thereby providing the researcher an opportunity to capture a specific aspect of a facial expression (e.g. the onset, apex or offset) for static presentation, rather than rely on accurate timing when taking photographs.

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[28] After all we tend to move, especially our faces, rather than remain rigidly still during actual social interactions.

Extraneous Factors

In the interests of experimental control, factors irrelevant to the difference between posed and genuine smiles, or those that may confound or obscure this difference, ought to be eliminated when generating these facial displays. For instance, spectacles are likely to cover parts of the area of the face where the Duchenne marker occurs (i.e. the outer corners of the eyes), thereby potentially occluding relevant information. In a similar sense facial hair, hair styles that cover parts of the face, or excessive make-up may impede the detection of facial expressions[29]. Efforts should also be made to ensure homogenous lighting, camera angle and background, as well as standardising the clothing worn by the 'models'. In short, all practical efforts should be made to control factors extraneous to the distinction between posed and genuine smiles.

Summary of requirements.

In summary, to ensure the ecological validity of posed and genuine smile displays, the researcher must ensure that:

1. Posed and genuine smiles are distinct in terms of the underlying emotional state of the expresser. Specifically, genuine smiles should be accompanied by positive affect, while posed smiles should occur, as far as possible, in the absence of any emotional state.
2. Posed and genuine smiles are distinct in terms of physiognomy. Specifically genuine smiles should show evidence of *orbicularis oculi* and *zygomatic major* contraction (i.e. FACS AU6 & AU12 respectively), while posed smiles should show evidence of *zygomatic major* contraction only (i.e. FACS AU12).

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[29] In this sense, individuals who do not have the normal range of movement of their facial muscles (e.g. due to illness, injury or cosmetic procedures such as *Botulinium* toxin injections) are also not suitable candidates for the generation of posed and genuine smiles.

3. All required facial expressions (i.e. neutral expression, posed smile, genuine smile) are sourced from all expressers.
4. A direct gaze (i.e. eye contact is made and maintained with the recording device) is present during all expressions.
5. The mode of presentation is appropriate for the research aims. Although both static and dynamic presentations of facial expressions provide valid information to the social perceiver, dynamic expressions are more informative and, therefore, preferable. If the research dictates that static photographs of facial expressions are required, these should be sourced from dynamic representations.
6. All extraneous factors such as clothing, hairstyle, lighting, and facial hair are controlled for.

Facial Displays Used in Previous Research

Line Drawings, Cartoon Faces and Computer Generations

Previous research investigating the perception of emotional facial expressions has employed a range of materials with varying degrees of ecological validity. At the lower end of mundane realism, several researchers have employed cartoon caricatures or line drawings to represent facial expressions of emotion (e.g. Eger, Jedynak, Iwaki, & Skrandies, 2003; Niedenthal, 1990; Stapel, Koomen, & Ruys, 2002). Often as simple as a typical *emoticon*[30] commonly used for electronic communication (e.g. ☺), cartoon depictions of emotional expressions fall substantially below acceptable levels of realism and fidelity. While impoverished displays are routinely used in social perception research to isolate particular information to which perceivers can be

[30] The Collins Concise Dictionary 21st Century Edition (2001) defines an emoticon as: any of several combinations of symbols used in electronic mail to indicate the state of mind of the writer, as in :-) to indicate happiness or :-o to indicate surprise.

sensitive (e.g. Hill, Jinno, & Johnston, 2003; Johansson, 1973; Runeson & Frykholm, 1983), such displays are typically derived from actual events. Cartoon faces, on the other hand, are constructions intended to simulate an actual face. While very high-fidelity drawings and animations approaching photographic realism, are possible to create using specialist software (e.g. Poser4), the dynamic nature of facial expressions of emotion has not been described or modelled in sufficient detail to enable accurate mapping from a real face to a cartoon or computer animation[31]. Hence, without specific knowledge of the nature of the complex changes occurring across the entire face when an expression of emotion is evident, the information available to the perceiver from cartoon or computer generated faces can at best, only be an approximation of that available during social interaction. As a consequence, the ability to generalise from responses to cartoon faces to responses in the real world is severely limited. In summary, in light of the current knowledge of the exact dynamics of facial expressions of emotion, these abstract representations of facial expressions of emotion do not fulfil criteria for ecological validity in that simplified cartoons or drawings, or computer generated faces are unlikely to contain the emotion specific information present in actual human faces that specifies the social affordances of an interaction situation.

Posed Emotional Expressions

An obvious alternative to schematic drawings of faces and cartoon figures is to use actual faces. However, the researcher is then confronted with the issue of how to elicit the requisite expressions of emotion when photographing or video-taping a face. A very common solution is to ask the individual to assume or pose a particular facial

[31] By comparison, the dynamics involved with the changes in facial appearance and structure associated with aging have been mathematically modelled in detail (e.g. Mark, Shaw, & Pittenger, 1988) and hence can be applied with accuracy to a computer generated image.

expression or emotion. Several approaches to posing emotions have been adopted by investigators that generally vary in regard to the context and instructions provided to the poser. For example, Mehta, Ward and Strongman (1992) constructed expressions of anger, contempt, disgust, fear, sadness, happiness, and surprise with "the assistance of six male models who posed seven emotions and a neutral expression" (p. 75). Alternatively, Leonard, Voeller and Kuldau (1991) provided more contextual cues for the required facial expression of happiness by asking participants to "think of a situation that would make them very happy and then to show the experimenter how they would look in that situation" (p.167). Other researchers (e.g. Ekman & Friesen, 1971; Ekman, Friesen, & Ellsworth, 1972) have used a similar technique which requires individuals to read a vignette about a person having an emotional experience, and then adopt the facial expression that person would be showing as a form of role-playing. Finally, researchers often simply provide instructions as to how the behaviour is meant to occur. For instance, Rochat, Striano and Blatt (2002) reported research concerning the effects of facial expressions of emotion on infants, whereby the experimenter "assumed a large, toothy, static smile with an upturned mouth, lifted cheeks, and creased outside eye corners" (p.292).

Unfortunately, employing posed facial expressions of emotion has the potential to severely limit the generalisability of results obtained from research employing these expressions to spontaneous facial expressions occurring in the context of actual social interactions. According to Motley and Camden (1988), "it seems quite possible that findings from typical studies of posed facial expressions in fact have little to do with the more spontaneous nonverbal behaviours of interpersonal communication interactions" (p.3). Taking the case of smiling as an example, it appears unlikely that even accomplished actors will be able to consistently and adequately pose genuine smiles. As discussed in Chapter 1, there is evidence to suggest separate neural pathways are associated with the production of spontaneous and deliberate facial expressions, which result in visibly distinctive patterns of facial movement (Gazzaniga & Smylie, 1990; Rinn, 1984). Indeed, Ekman, Roper and Hager (1980) reported that less than 20% of individuals are able to voluntarily contract *orbicularis oculi pars lateralis*. If, in fact, an individual can produce a physiognomically genuine smile on demand, there is still no guarantee this expression will adequately resemble that produced spontaneously when an individual is actually happy.[32] Deliberate facial expressions are unlikely to reflect the distinction in emotional state that is required for ecologically valid posed and genuine smiles (Alley, 1988b; Motley & Camden, 1988), and therefore are not suitable for use in the present research.

Imitated Emotional Expressions

A further strategy for generating facial expressions of emotion is to instruct models to imitate a prototypical photograph of the expression being sought, often by being told which facial muscles to contract or relax (e.g. Ekman, Friesen, O'Sullivan, Chan, Diacoyanni-Tarlatzis, Heider et al., 1987; Matsumoto & Ekman, 1988). The researcher then compares the resultant expression with the prototypical expression

[32] Even if a posed genuine smiles appears morphologically adequate, as discussed, the relative presence or absence of a positive emotional state is critical to the valid operationalisation of genuine smile facial displays. Simulating a genuine smile in the absence of positive affect does not qualify as a genuine smile, while, alternatively the presence of sufficient positive affect suggests that posing isn't necessary to produce the required genuine expression. In this sense, the Stanislavski method of acting whereby the actor 'inhabits the mind' of the character they are playing (e.g. if the character is happy, the actor ought to be happy as well, rather than simply 'acting happy') may be a useful approach to such mood induction and subsequent production of a genuine expression of emotion. Furthermore, the Facial Feedback Hypothesis (Tourangeau & Ellsworth, 1979), which states that facial movement can influence emotional experience, may also assist the actor to generate genuine smiles. Ekman and Davidson (1993) and Soussignan (2002) have demonstrated that specific manipulations of the face to resemble a smile can evoke a positive emotional experience, which in turn may provide the ontological basis for a genuine smile.

and often, after feedback, repeats the process until a suitable match is obtained. This approach suffers from similar shortcomings to simply posing facial expressions in that it is likely there will be no emotional experience to accompany the expression and most individuals are not able to contract *orbicularis oculi pars lateralis* on demand. Furthermore, imitating prototypical expressions requires precise knowledge of the meaningful features of those expressions that need to be replicated. In the case of smiling, there is still much research to be conducted to adequately identify the nature of the transformational invariants necessary and sufficient to specify positive affect to the observer (Frank et al., 1993). Thus, comparison between an imitated genuine smile and a spontaneous genuine smile is, at best, an approximate evaluation of those factors currently acknowledged to reflect the distinction between posed and genuine smiles. In view of these shortcomings, imitated facial expressions of emotion are unlikely to offer sufficient levels of ecological validity.

Spontaneous Facial Expressions

Finally, although clearly in the minority, a number of researchers have employed spontaneous facial expressions of emotion as experimental displays (e.g. LaRusso, 1978; Motley & Camden, 1988; Scherer & Ceschi, 2000). Obviously, using spontaneous facial expressions provides a convenient match from the laboratory to the reference situation of actual social interaction where spontaneous expressions occur, which, in turn, provides potential for high levels of ecological validity. However, there are a number of practical difficulties in sourcing such spontaneous expressions. Essentially, as outlined above, the researcher must have a means to control for any extraneous factors accompanying the emotional expression. Spontaneous expressions of emotion are likely to be influenced by context because emotions other than the emotion of interest may also be expressed, thereby confounding the resultant expression. For instance, in a naturalistic setting, participants, without specific instruction, may not always maintain eye contact with the recording device. Nonetheless, it appears at present that if these issues of experimental control can be addressed, using spontaneous expressions of emotion may represent the best available option for ensuring ecologically valid genuine smile displays. To this end, a reasonable approach is to attempt to elicit spontaneous expressions in a controlled laboratory environment. As such, this approach was adopted for the present research and is described in the method section below.

Facial Expression Sets

In addition to the varieties of facial expression displays described above, a number of sets of facial expressions are available either commercially or for research purposes. Among these sets, 'Pictures of Facial Affect (POFA)' (Ekman & Friesen, 1976); 'Photographs of Chinese Facial Expressions' (Wang & Markham, 1999); 'Japanese and Caucasian Facial Expressions of Emotion (JACFEE)' (Matsumoto & Ekman, 1988); and Diagnostic Analysis of Nonverbal Accuracy (Nowicki, Glanville, & Demertzis, 1998) are commonly employed as sources of facial displays for emotion perception research (e.g. Elfenbein & Ambady, 2003; Esteves & Ohman, 1993; Fernandez-Dols, Carrera, & Russell, 2002; Frank & Stennett, 2001; Glanville & Nowicki, 2002; Marsh, Elfenbein, & Ambady, 2003; Williams, Senior, David, Loughland, & Gordon, 2001). Unfortunately, none of the aforementioned sets of facial expressions are known to include the range of expressions (i.e. neutral expression, posed smile, genuine smile) at the level of ecological validity required for the present research.

Posed and Genuine Smile Displays Used in Previous Research

Approaches to the operationalisation of facial expressions of emotion discussed to this point have considered facial expression research in a global sense. However, as discussed in Chapter 1, a small number of studies have specifically examined aspects of social perception relevant to posed and genuine smiles, which, for obvious reasons, warrant attention here. These studies have employed various forms of experimental materials to examine perceiver's sensitivity to the difference between posed and genuine smiles. At the lower end of ecological validity, Brown and Moore (2002) used emoticons featuring eyebrows, eyes, and mouth only. Smile type was manipulated by representing the mouth as a symmetrical, upwardly curving line for the genuine smile, and an asymmetrical upwardly curving line for the posed smile. The asymmetry manipulation was applied to the left-hand side of the face in accordance with the literature describing the differences in symmetry between posed and genuine smiles (Ekman et al., 1988; Gazzaniga & Smylie, 1990; Rinn, 1984). Although this manipulation appears theoretically sound, line drawings may not, as discussed above, adequately replicate the information available to perceivers during a social interaction, and hence cannot be generalised to actual faces and interactions.

Surakka and Hietanen (1998) reported guiding actors to produce static facial expressions corresponding to a neutral expression, a posed smile, and a genuine smile. The resultant expressions were then assessed against FACS criteria. Again, as discussed above, either posing or imitating spontaneous facial expressions is not sufficient to produce ecologically valid facial expressions. Although Surakka and Hietanen verified the physiognomic distinction between the posed and genuine smiles, they failed to report any distinction in terms of the emotional state accompanying the respective expressions. The results of this study, therefore, are also shaded by questionable generalisability.

Finally, Frank et al., (1993) employed posed and genuine smile displays when investigating differences in perceptions and impressions of individuals exhibiting these expressions. The expressions employed were sourced from two previous studies: namely Davidson, Ekman, Saron, Senulis and Friesen's (1990) study which investigated brain activity during facial expressions of emotion, and the classic Ekman et al. (1988) study with nursing students (see Chapter 1 for details). To recap, Davidson et al. filmed participants while they were wearing lycra skull caps to measure brain activity using electroencephalogram (EEG). The presence of the skull cap creates a somewhat unusual appearance that is potentially problematic for the present research. It is simply unknown what effect these caps may have in regard to social perception. Alternatively, Ekman et al. surreptitiously recorded facial expressions while nursing students were viewing either nature scenes or graphic medical scenes, under the instruction to suppress any negative expressions. While this is a laudable approach, the posed smiles generated were in fact *masking* smiles (Ekman et al.; Frank et al.), intended to hide signs of negative affect. Hence, these smiles are likely to be confounded with the presence of micro-expressions and other visible contaminants of the negative affective experience. As a consequence, any comparison between posed and genuine smiles using these displays must somehow account for the underlying negative emotion, which, in theory, accompanied the posed smiles. As outlined above, it is preferable to employ materials that only reflect the difference between the positive affective state accompanying genuine smiles and the relative absence of affective state accompanying posed smiles, rather than any, more complex interplay of other emotional states.

The Present Research

Because of the limitations of the aforementioned approaches to the generation of ecologically valid facial displays, and hence the lack of suitable commercially available experimental materials, there was a necessity to generate original posed and genuine smiles for use in the present research. The remainder of this chapter will outline the procedure employed for generating and recording posed and genuine smiles. The resulting expressions will be described following the overview of the procedure.

Overview of Facial Display Generation Procedure

The intention of this procedure was to elicit ecologically valid posed and genuine smiles in accordance with the requirements outlined above, and in a context where recording these expressions using video would be feasible. As such, participants were recruited individually and were made aware that the procedure involved recording their facial expressions, but they were not informed of the specific purpose of the procedure, namely the generation of posed and genuine smiles. The procedure implemented involved asking participants to pose smiles as they would in various contexts as well as exposing them to sounds and pictures that have previously been shown to elicit positive affect in order to elicit spontaneous genuine smiles. Motley and Camden (1988) have criticised the use of emotionally laden materials to elicit spontaneous facial expressions of emotion on the basis that "the kinds of emotional responses they try to elicit...differ from those likely to be found in natural communication settings" (p. 5). It remains an empirical question as to whether this criticism is warranted with respect to the validity of this specific procedure. No research is known to have considered this issue with any rigour. The approach of employing emotionally laden sounds and photographs is favoured in the present research as these materials have been previously shown to reliably elicit emotions (e.g. Bradley & Lang, 1999b; Lang, Bradley, & Cuthbert, 2001) at reasonable levels of intensity. It is acknowledged that each expression may be specific to the sound or photograph presented (such specificity is likely to be very subtle however as spontaneous expressions tend to be readily identifiable regardless of context, Elfenbein & Ambady, 2002; Frank et al., 1993), but this is true for any emotional experience, whether elicited in the laboratory, or occurring during actual interaction. In line with the ecological approach to psychology, cognition always has a referent. For instance, in the present case, individuals expressing a genuine smile must be considered to be 'happy about' something, rather than simply 'happy'. In this sense, such contextual specificity is therefore unavoidable, although the effects of the 'communication setting' of the laboratory are unlikely to be large if truly spontaneous, genuine facial expressions of emotion are obtained.

The procedure consisted of five phases which elicited: (I) neutral expressions; (II) posed smiles; (III) positive mood; (IV) genuine smiles (from sounds); and (V) genuine smiles (from photographs), during which the participant's face was continually videotaped· Participants made ratings of their mood prior to each phase of the procedure. The video recordings were subsequently examined for evidence of the requisite facial expressions and coded according to FACS criteria. It was intended that by including various methods of expression elicitation and a number of individuals, a range of ecologically valid posed and genuine smiles of varying intensities from various individuals would be produced. These could then form a pool of expressions to be selected from for use in subsequent experimental procedures.

Method

Participants.

Thirteen participants (8 female[33]) were recruited to take part in what was described as a pilot study to determine the effects of various modes of presentation of information on mood. Only individuals who complied with the requirements for generating posed and genuine smile displays as outlined above (no facial hair, no spectacles etc.) were recruited. All participants wore a standard, white laboratory coat for the duration of the procedure.

Apparatus.

Instructions and materials were presented via a standard 17inch colour computer monitor using Microsoft PowerPoint software on a PIII 750Mhz personal computer running Windows XP. Participants were seated approximately 100cm from the screen, in front of a blank, neutral coloured, background. Video recordings were made using a Canon XM2 3CCD digital video camera mounted above the computer monitor. The recordings were subsequently captured and converted to computer files using Adobe Premier software for editing and coding. Each recording was captured in PAL format at 25 frames per second, standardised for brightness and contrast, and compressed using a Microsoft MPEG4v2 codec.

[33] Both male and female participants were recruited for the facial expression generation procedure in order to provide the potential to examine sex differences in the subsequent experiments.

Materials.

Prior to each phase of the procedure, participants made ratings of their mood on an analogue scale (see Appendix B). Each scale consisted of a 200-mm vertical line anchored at the top by the label "Very positive" and a positive expression emoticon (e.g. ☺), and at the bottom with the label "Very negative" and a negative expression emoticon (e.g. ☹). The mid-point of the scale was labelled "Neutral". Participants were simply required to indicate their current mood with a horizontal line on the scale. Mood was scored by measuring the distance (in mm) from the centre point of the scale marked "Neutral" to the line made by the participant. Thus, mood scores could potentially range from -100 (very negative) to 100 (very positive).

During the positive mood induction phase (Phase III) of the procedure participants were played a 4-minute 5-second recording of classical music. This clip consisted of portions of three allegro movements, two composed by Mozart (*Divertimento in D Major 136* and *Eine Kleine Nacht Musik*), and one by Vivaldi (*Concerto for Mandolin, Strings and Harpsichord*), which have previously been shown to induce a positive emotional state (Halberstadt & Niedenthal, 1997).

During the first genuine smile elicitation phase (Phase IV) of the procedure participants were played a series of sound clips sourced from the International Affective Digitized Sounds (IADS) database (Bradley & Lang, 1999b). IADS is a set of 120 emotionally evocative sound clips that have established norms for ratings of valence, arousal, and dominance associated with each clip. Normative ratings have been established independently for males and females. For the purposes of the present study, clips were selected separately for male and female participants based on ratings of valence and arousal. Twenty clips with the highest normative valence ratings (i.e. those clips that were rated as the most positive) were selected for male and for female participants respectively. From each set of 20 clips, 11 were selected to play to the participants, on the basis of adequate arousal level (>5 on a 9-point scale) and with a view to ensuring a mixture of content types (e.g. music, crowd noise, laughing, eroticism) while avoiding too much repetition. A complete list of the IADS materials used is presented in Appendix C.

During the second genuine smile elicitation phase (Phase V) of the procedure participants were shown a series of static images sourced from the International Affective Picture System (IAPS) database (Lang et al., 2001). IAPS is a set of approximately 700 emotionally evocative photographs that have established norms for ratings of valence, arousal, and dominance associated with each image. Normative ratings have been established independently for males and females. For the purposes of the present study, images were selected separately for male and female participants based on ratings of valence and arousal. Thirty images with the highest normative valence ratings were selected for male and for female participants respectively. From each set of 30 images, 20 were selected to show to participants on the basis of adequate arousal level (>5 on a 9-point scale) and with a view to ensuring a mixture of content types (e.g. babies and baby animals, sports, nature scenes, eroticism). A complete list of the IAPS materials used is presented in Appendix C.

Procedure.

Initially, the participants were welcomed to the laboratory and briefed as to the purposes of the procedure. They were informed that the study was a pilot test intended to assess various modes of presentation of emotional information on mood and emotional state. Furthermore, they were told that their faces would be video-taped for the duration of the procedure, but the experimenter had no prior expectations of how the participant would behave as this was a pilot study intended to pre-test a range of materials, some of which would be selected for use in subsequent research. It was stressed to participants that they should try to relax and behave as naturally as possible so as not to unduly influence their responses. After agreeing to take part, participants were seated approximately 100 cm in front of the computer screen and asked if they had any questions about the procedure. After any questions had been resolved, the experimenter informed participants that all instructions would be presented via the computer screen, and then left the room. The timing of the instructions presented on the screen was controlled by the participants who were prompted to click the mouse when ready to continue.

Phase 1 – Neutral Expression.

During the first phase, participants were instructed to complete a mood scale, followed by instructions to relax and look into the camera with a neutral facial expression. They were asked to hold their gaze and the facial expression for approximately 10 seconds.

Phase 2 – Posed Smile.

Participants were then instructed to complete a second mood scale followed by a request to look into the camera and smile for approximately 10 seconds. This instruction was repeated a further 5 times, and each time was accompanied by a contextual description of a reasonably common situation where a posed smile may be expected (e.g. “Please smile as you would for your passport photo”). A list of all the contextual descriptions is presented in Appendix C.

Phase 3 – Positive Mood Induction.

Participants next completed a third mood scale and were then informed they would be hearing a few minutes of classical music (see Materials for more detail). They were invited to take this time to relax, to concentrate on the music, and to think about any positive events that had happened to them recently. Once the music had finished, the procedure automatically continued to the next phase.

Phase 4 – Genuine Smile [IADS]

Participants then completed a fourth mood scale and were subsequently informed that they would be hearing a series of short clips of sounds they might encounter in everyday life. They were instructed to concentrate on the sounds and try to imagine a situation in which that sound might occur, but to remain looking into the camera while each sound was playing. Each of the IADS clips lasted approximately 10 seconds and was followed by a 5-second pause before the procedure automatically continued to the next sound. A complete list of the IADS sounds used is presented in Appendix C.

Phase 5 – Genuine Smile [IAPS]

In the final phase, participants completed a fifth mood scale, after which they were informed that they would be presented with a series of photographs on the computer screen. They were instructed to look at each photograph and then look into the camera while thinking about the photograph and how it made them feel. Each of the IAPS images remained on the screen for 15 seconds, after which it was immediately replaced by the next image in the series. A complete list of the IAPS photographs used is presented in Appendix C. Once the participant had viewed all 20 photographs they completed a sixth mood scale.

The entire procedure lasted approximately 45 minutes for each participant, after which they were debriefed as to the purpose of the procedure, thanked for their time and paid $10. All participants provided consent for their images to be used for the present and future research.

Coding.

The video recording for each participant was edited into discrete segments corresponding to each individual stage of the procedure (i.e. posed smile instruction, IADS sound or IAPS photograph). Each segment lasted for the duration of the IADS/IAPS material presented or the behaviour requested in the case of neutral expressions and posed smiles. Care was taken to ensure smiles were not split across more than one segment, that is both the onset and offset of each smile observed were included in the same segment. Segments were then visually inspected for the presence of any form of smiling. Segments which featured smiling were subsequently coded for evidence of *zygomatic major* and/or *orbicularis oculi* contraction according to the FACS criteria for AU12 and AU6 respectively. Other features related to each expression, in particular any other muscle activity, were noted. An overview of the results of the coding procedure is presented for each participant in Appendix D.

Results

Emotional state.

The ratings of mood provided by participants on the analogue scale were intended as self-reported approximations of mood or emotional state. Although there are a number of problems with measuring mood by relying on self-report (see Plutchik, 2003), physiological and neurological means for assessing emotional state are simply too invasive to be of practical use in the current procedure. Furthermore, referencing emotional state in terms of behavioural outcomes, in this case a smile, fails to fulfil the requirements of both a physiognomic and emotional distinction between posed and genuine smiles. Hence, self-report of mood state, although not ideal, was the best available option for the current procedure. The use of an analogue scale also helps overcome some of the difficulties associated with the use of ordinal scales such as Likert scales or other such categorical approximations to continuous measurement (Ferrando, 1999).

Given the mood scale ratings were self-reported approximations to emotional state, it is only appropriate to analyse these responses in terms of a visual inspection by individual participant. A graph of each participant's ratings of their mood is provided in Appendix E. Only expressions from those participants who reported feeling more positive at some stage between the beginning of the mood induction phase (phase III) and the end of the procedure were considered potentially genuine smiles. Only two participants (F3 and F4, see Appendix E, Figures E3 and E4) failed to meet these criteria. As such, only posed smiles were subsequently identified and coded from these participants.

FACS criteria.

As described, each segment from each participant's video was examined for the presence of signs of smiling. Each smile identified was then subsequently coded for the presence of FACS AU6 and AU12 with the limitation that only smiles occurring during the mood induction or genuine smile phases of the procedure (phase III-V) could be considered genuine smiles. Neutral expressions and posed smiles were obtained from all participants, while genuine smiles were obtained from 9 participants only.[34] In total, 165 posed smiles and 40 genuine smiles were generated that met the requirements for ecological validity outlined above (see Appendix D, Table D14 for a summary for each participant).

Summary

This section summarises the procedure used for the generation of facial displays for the subsequent research, in relation to the 6 requirements for ecologically valid posed and genuine smile displays, outlined earlier in this chapter.

1. *Emotion distinction:* Of the 13 participants who took part in the facial display generation procedure, 11 reported discernable increases in mood between the beginning of the mood induction (Phase III) and the genuine smile (Phases IV and V) stages of the procedure. Thus, only the 11 participants who exhibited a positive change in mood were considered when examining the video-clips for evidence of ecologically valid genuine smiles. One potential problem associated with this approach[35] concerns the emotional state of participants

[34] As described above, two participants (F3 and F4) did not meet the criteria for an increase in positive affect. Two additional participants (F2 and M1) did not genuinely smile at all during the procedure.
[35] In addition to the potential methodological short-comings associated with self-report measures of emotion discussed, see Plutchik (2003) for an overview.

during the posed smile (Phase II) stage of the procedure. Technically, it is preferable for participants to be in a neutral emotional state when posing smiles, as there is a potential risk of morphological confounding due to unintended emotional expressions. However, this may be indeed difficult to achieve. The nature of the procedure (i.e. knowingly being filmed) may leave some participants feeling, for instance, anxious, while others appeared to enjoy the experience. Self-report of emotion, in this case, fails to provide a suitable baseline for neutral mood, rather only a reference point for comparison with subsequent reported emotional experience can be established. Only careful scrutiny of the facial expressions sourced from the posed smile (Phase II) stage of the procedure to reveal evidence of other emotional experience can help overcome, or at least minimise this problem in the context of the present research.

2. *Physiognomic distinction:* As discussed, only smiles which met FACS criteria for evidence of recruitment of *zygomatic major* (FACS AU12) either with (i.e. genuine smiles) or without (i.e. posed smiles) contractions of *orbicularis oculi* (FACS AU6) were considered as candidates for ecologically valid expressions.
3. *Individual differences:* Both male and female participants were recruited for this procedure to allow for inclusion of sex as a factor in the planned research. Furthermore, all required facial expressions (i.e. neutral expression, posed smile and genuine smile) were successfully obtained from 9 participants.
4. *Gaze direction:* Participants were required, and reminded throughout the procedure, to look directly into the camera. Only expressions for which direct

eye contact was maintained for the majority of the duration of the expression were considered valid for use in the planned research.

5. *Static and dynamic expressions:* The initial recording of the participants' facial expressions using digital video allows for static images to be subsequently developed from this source. Thus, both dynamic and static representations of the required facial expressions were obtained from the present procedure. The video clips were edited so that both the onset and offset of each expression were included in each clip. The static expressions were obtained by identifying the apex of each expression and capturing a still image from the video clip at this point.
6. *Extraneous factors:* All attempts were made to control for the effects or factors thought to impact social perception but not pertinent to the present research. Only participants with no facial hair or spectacles were recruited, and those who took part were required to remove any excess make-up or jewellery, and to wear a standard white laboratory coat. Despite these efforts, one participant's hair occluded parts of her face and, therefore, no valid genuine smiles were obtained from her.[36] Furthermore, the use of standard lighting, background and camera position ensured a regular appearance in all the resulting video clips and photographs.

In summary, it appears the facial displays generated for the present research adequately fulfilled the criteria outlined for ecologically valid posed and genuine smiles. Importantly, each form of smile was distinct (from the other) in terms of both emotional state and physiognomic appearance. All required expressions were obtained

[36] This participant (F3) also failed to meet the criteria for an increase in positive mood during the genuine smile generation phase.

from 9 participants in both dynamic and static modes, and efforts were made to control gaze direction and extraneous factors such as clothing, lighting, and the general appearance of the resulting materials. Thus, it is suggested that the facial expressions generated using this procedure are suitable for use as ecologically valid facial displays in the present research.

CHAPTER 4

Detectability of Emotional State Specified by Posed and Genuine Smiles

As discussed in previous chapters, the ecological approach to psychology requires the researcher to consider the animal-environment interaction as a singular unit for analysis (Gibson, 1979; McArthur & Baron, 1983; Reed, 1996). That is, a coherent explanation of a psychological phenomenon requires that the properties of the animal, in concert with properties of its environment, be taken into account. Before examining the nature of the animal-environment relationship more closely the researcher must, at the outset, understand what is available for perception (i.e. the informational properties of the environment), in combination with the sensitivity of the animal to such properties. Only in this manner can the mutual, reciprocal relationship between the animal and its environment be properly understood in terms of a genuinely monistic ecological approach.

In regard to the present research, the literature reviewed in Chapter 1 pertaining to the ontological distinction between posed and genuine smiles provides an account of the structural qualities available for perception that specify the distinction between these facial expressions (for an overview see Ekman, 2003; Ekman, Friesen, & O'Sullivan 1997; Frank, 2002; Frank, Ekman, & Friesen, 1993). In brief, genuine smiles involve contraction of the *orbicularis oculi* (i.e. show evidence of the Duchenne marker), tend to be facially symmetrical, show a smooth, temporally consistent transition between onset, apex, and offset, and have a uniform temporal duration. By comparison, posed smiles do not involve *orbicularis oculi* contraction, tend to be asymmetrical, show little regularity between onset, apex, and offset, and occur over variable durations. In terms of social significance, only smiles that involve *orbicularis oculi* contraction spontaneously occur in the presence of a positive affective experience. All other smile varieties can be considered volitional communicative mechanisms, ontologically distinct from a genuine expression of happiness. Thus, there appears to be a basis for the perceiver to distinguish between posed and genuine smiles in terms of the information available for perception. Systematic, lawful constraints on the social environment (i.e. the relationship between emotional experience and facial efference) structure optical information such that there is potential for the attuned perceiver to detect the veracity of a smile. Smile veracity in and of itself, however, does not sufficiently describe that which is specified by the distinct morphologies of posed and genuine smiles. In theory, what the perceiver needs to be sensitive to is information relevant to the affordances of their environment. As aforementioned, the emotional state of conspecifics has bearing on opportunities for interaction. Smile veracity, in this sense, provides the social perceiver with an avenue to detect happiness, and therefore, to inform interaction. What remains to be investigated is the propensity of perceivers to be sensitive to this emotion-specific information. In order for posed and genuine smiles to be considered as candidates for ecological referents of emotional state, and in turn the associated social affordances, perceivers must be able to reliably distinguish between these facial expressions, or more appropriately, between expressions that specify happiness and those that do not. This chapter reviews previous research that has directly examined the sensitivity of perceivers to the distinction between posed and genuine smiles. Following this review the first study in the present research, which was intended to replicate and extend the literature reviewed, is reported.

Previous Research Investigating the Detectability of Smile Veracity

As discussed in Chapter 1, in contrast to the research conducted on the nature of the differences between posed and genuine smiles, there is a relative dearth of enquiry regarding the sensitivity of perceivers to such differences. Although Darwin (1872/1998) remarked on how well observers could distinguish between photographs of posed and genuine smiles, since then only a handful of studies are known to have addressed this issue with any rigour (e.g. Frank et al., 1993; Scherer & Ceschi, 2000; Williams, Senior, David, Loughlan, & Gordon, 2001).[37] Of these, only Frank et al. have directly compared perceptions of posed and genuine smiles. In the second of three studies reported by these authors, participants were required to judge, from video, whether a particular smile:

> is a true, genuine expression of enjoyment (i.e. she is truly happy or enjoying herself) or if in fact this smile is a false or social expression (i.e. she is smiling because it is socially appropriate but is not necessarily happy herself). (p.88)

The results revealed that participants were significantly more accurate than chance (i.e. 50% correct) at distinguishing posed from genuine smiles both when viewing smiles individually ($M = 56\%$ correct), and in pairs where both posed and genuine smiles from one individual were seen simultaneously ($M = 73\%$ correct). These results suggest that when making explicit judgements of smile veracity, observers were able to accurately detect the difference between posed and genuine smiles.

Furthermore, Frank et al. (1993) reported that factors associated with increasing the salience of *orbicularis oculi* action resulted in greater accuracy in distinguishing

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[37] With the exception of Frank et al. these studies will be reviewed in more detail in Chapter 5.

between posed and genuine smiles. Salience was influenced by characteristics of the perceivers' viewing strategies, characteristics of the facial expressions, or a combination of both. Participants who reported focussing on the area surrounding the eyes when making smile veracity judgements were more accurate than those who did not report using this strategy. Viewing smiles in pairs, which allowed for a direct visual comparison between smiles, was also associated with an increased ability to identify smile type. Additionally, low intensity genuine smiles, that is, genuine smiles in which *zygomatic major* contraction does not change the appearance of the face beyond changes to the mouth, were more distinguishable from posed smiles and moderately intense genuine smiles. Frank et al. reasoned that as moderately intense contraction of *zygomatic major* can result in the bagging of skin below the eyes, these morphological changes are potentially confused with changes in appearance due to *orbicularis oculi* contraction. Furthermore, the latter two factors interacted such that the increased ability to accurately identify low intensity genuine smiles was only manifest in the paired smile condition. Considering these three factors in combination, the ideal observers (i.e. those that reported adopting the 'eye-checking' strategy) viewing smiles under optimal conditions (i.e. low intensity smiles in pairs) were reported to show the highest accuracy rates ($M = 81\%$) in this study. Frank et al. suggested that by making the action of *orbicularis oculi* more conspicuous, the 'signal strength' of this marker is amplified, and therefore, made more detectable to the social perceiver.

However, while the conclusions drawn by Frank et al., (1993) appear reasonable in light of the results reported, a number of methodological issues preclude the elimination of alternative explanations. First, the smiles employed by Frank et al.

were sourced from two previous studies, (Davidson, Ekman, Saron, Senulis, & Friesen, 1990; Ekman & Friesen, 1974). Both of these studies elicited spontaneous genuine smiles by showing participants positively valenced video clips, but in line with the specific aims of each study, the respective methodologies varied in a manner that potentially influenced factors associated with person perception. As mentioned in Chapter 3, in the former study Davidson et al. measured brain activity using electroencephalogram (EEG). This technique is somewhat obtrusive because to support the EEG electrodes participants must wear a lycra skull cap. This is potentially problematic in that the skull cap is very apparent in the subsequent images of smiles, giving a very unnatural appearance to the individual expressing the smile. In the latter study Ekman et al. asked the participants (nursing students) to describe what they saw on the video. In addition to a pleasant nature scene, participants in this study also saw unpleasant medical training footage showing amputations and the treatment of severe burns, but were required to conceal any negative feelings they may have had while describing the medical scenes. In effect, the posed smiles sourced from this study were, in fact, *masking* smiles, intended to conceal negative emotions (Ekman & Friesen, 1982; Ekman et al., 1997; Frank et al.). As a consequence, these expressions are likely to contain leaked evidence of the concealed negative emotions in the form of microexpressions, brief traces of facial expressions of emotion generally associated with negative emotional experience and often occurring when attempts are made to suppress expression (Ekman, 2001, 2003). It is clear that neither of these sets of smiles fully meet the criteria for ecologically valid displays of facial affect outlined in the previous chapter. Therefore, these findings may suffer from a lack of generalisability from the research setting to the real world.

Second, Frank et al. (1993) explicitly provided participants with an a priori expectation of the proportion (50%) of posed and genuine smiles they would be viewing. This knowledge potentially assisted participants in the individual presentation condition when making judgements of smile type. Specifically, there may have been a tendency to use the base-rate information provided to adjust response strategy in order to ensure approximately half of the smiles viewed were categorised as 'social' and half as 'enjoyment'. Such an effect is likely to occur in the latter parts of the procedure whereby a bias toward the least frequently chosen smile type may become evident. Systematically varying the order of smile presentation, or randomly varying presentation order for each participant would help overcome this potential confound. However Frank et al. reported using a fixed order when smiles were presented individually, and they did not report their data in sufficient detail to enable consideration of such order effects. Furthermore, given the instructions they received, participants knew that all expressions presented would be smiles of some description. Hence, even if a participant believed that a particular expression they saw was not a smile or was in fact a different emotional expression, they knew that was supposed to be a smile as they were told at the beginning of the procedure that they would only be seeing smiles. Such a hypothetical participant would then be required to choose their response from two alternatives (social or enjoyment smile) they had already deemed to be incorrect. This situation may lead to decisions being made based on criteria other than physiognomy due to the participant's belief the expression they were seeing was not a smile[38]. In this sense, the forced-choice response format employed by Frank et al. constrained participant responses to a binary 'social' or 'enjoyment' smile distinction, thereby removing any potential for the participant to be

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[38] Although such data may well be informative, it should not be conflated with that of participants who do use physiognomic characteristics to judge smile type.

uncertain or to make a spontaneous attribution to any other emotional state. This may be particularly important when participants were viewing the smiles sourced from Ekman and Friesen (1974) which may have contained traces of suppressed negative emotion. In this case, the forced-choice response format employed by Frank et al. simply does not allow for accurate identification of the perceived emotional state. These problems were exacerbated in the paired smile condition, whereby participants knew that one of each pair of expressions presented was a genuine smile, and one was not. Even if they failed to distinguish between the two smiles presented (i.e. they thought both smiles were either posed or genuine, or could not tell), the forced-choice response employed, does not allow any scope for judgements beyond the binary options of 'social smile' or 'enjoyment smile' required by the experimental procedure. It has been suggested that the use of a forced-choice response format in this manner may produce artificially high consensus rates amongst participants (Russell, 1994). Interestingly, in a later paper concerning methodological requirements for research on perception of facial expressions of emotion, Frank and Stennett (2001) argue that in order to overcome the tendency for forced-choice paradigms to enhance artifactual agreement rates, a 'none of these terms are correct' option should be included. While it is impossible to draw any conclusions regarding the impact of either the use of a forced-choice response format without a 'none correct' option, or of the a priori provision of base-rate information, on the results reported by Frank et al., it is clear these factors provide potential for methodological confounds.

Finally, Frank et al., (1993) measured the ability of perceivers to distinguish between posed and genuine smiles using accuracy rates; specifically, the proportion of smiles correctly identified. To be deemed correct, a genuine smile needed to be classified as an 'enjoyment smile', and a posed smile as a 'social smile'. The observed proportion of correct identifications was then compared with the proportion expected if responses were random (i.e. at a chance level of success) to determine if perceivers were able to reliably determine which smiles were posed and which were genuine. Although this approach is common in studies of emotion recognition accuracy (e.g. Ekman, Sorenson, & Friesen, 1969; Esteves & Ohman, 1993), the rate of correct identifications does not provide sufficient detail for an unambiguous interpretation of perceivers' abilities to discriminate between the different types of smiles presented. While a significantly higher-than-chance accuracy rate may indicate a sensitivity to the distinction between posed and genuine smiles, it does not rule out a competing explanation of bias. It may be that participants simply favoured one response over the other. Hypothetically, if participants were more willing to identify any given expression as an 'enjoyment smile', perhaps, for example, due to some form of response bias (Miller & Felicio, 1990), then it is likely that only smiles that clearly did not resemble a genuine smile (e.g. a low intensity, highly asymmetric posed smile) would not be classified as an 'enjoyment smile'. If it is assumed that such a response bias was not so extreme that all smiles were considered 'enjoyment smiles',[39] a participant exhibiting this bias would have produced a high (if not perfect) accuracy rate when viewing genuine smiles. Although tempered by a relatively lower level of accuracy when viewing posed smiles, this bias could quite feasibly have resulted in an overall accuracy rate significantly greater than chance. Thus, from the data reported by Frank et al. (1993) it is impossible to determine whether the observed ability of participants to distinguish posed from genuine smiles was indeed due to a

[39] This assumption appears reasonable in light of the *a priori* base-rate information provided by Frank et al. (1993). In this sense, however, it is acknowledged that the provision of base-rate information may limit the overall potential for impact of response bias on decision making. A participant may feasibly identify all smiling people as happy, however this is unlikely to occur if one knows, as was the case for Frank et al.'s participants, that only half of the smiling people they will see are actually happy.

perceptual sensitivity to this difference, or was in fact the result of a response bias. This issue warrants particular attention in that the potential role of response bias as described here is likely to be solely an artefact of methodology. Without base-rate information, as is the case in real-world interactions, participants are unlikely to attempt to conform to any expectations regarding the frequency with which they will encounter genuinely smiling individuals.

To summarise, while the research reported by Frank et al. (1993) provides a controlled laboratory demonstration of the ability of perceivers to distinguish posed from genuine smiles, it appears that aspects of the experimental procedure employed undermine the ecological validity, and therefore subsequent generalisability, of their findings from the laboratory to actual social interactions. The facial displays used by Frank et al. were not uniform with respect to the information available to perceivers. In half of the displays, the individual expressing the smile was wearing a lycra EEG skull cap, thereby creating a somewhat unusual appearance for the subsequent observers. In the other half, the individuals exhibiting the expressions had been instructed to suppress any evidence of negative emotion. These videos are likely to contain some evidence of the suppressed emotion, which was not accounted for by Frank et al. Furthermore, participants were informed prior to the procedure that half of the smiles they would see were posed and half were genuine. Obviously such base-rate information is not present in real-world interactions. This problem was exacerbated in the paired smile condition whereby participants saw the same person exhibiting one posed and one genuine smile. Although we may see a range of configurations of facial expressions from a given individual during actual interactions, it is simply never the case that we see any two expressions simultaneously, and therefore, are never presented with the opportunity to make direct comparisons as participants in Frank et al.'s research were asked to do. Finally, the results as reported by Frank et al. do not provide sufficient information to determine whether the observed ability of participants to determine which smiles were posed versus which were genuine, reflects an actual sensitivity to the differences between these expressions, or in fact, was the result of some form of bias. If claims regarding perceivers' sensitivity to the difference between posed and genuine smiles are to be considered tenable, then the role of bias must be considered. The remainder of this chapter will outline the first study in the present research, which was intended to replicate and extend the work of Frank et al. by addressing the methodological problems discussed.

The Present Research

To recap, the objective of the first study in this thesis is to investigate the ability of perceivers to detect emotional state, specifically happiness, by means of distinguishing between posed and genuine smiles. The research reviewed in previous chapters suggests that there are systematic physiognomic differences between smiles that are spontaneous expressions of positive affect and smiles that are posed, intentional communicative mechanisms, not necessarily related to any affective state. It has been argued that it is important for the social perceiver to be sensitive to the differences in emotional state specified by these two expressions or risk misperceiving the social affordances available in a given interaction. However, relatively little is known about whether perceivers are in fact sensitive to the differences between posed and genuine smiles. The only study known to have addressed this question directly did not report results in sufficient detail to rule out alternative explanations for the greater-than-chance accuracy rate found when participants were asked to distinguish posed from genuine smiles (Frank et al., 1993). Therefore, the present study is intended to partially replicate the research reported by Frank et al. with modifications to the procedure and analysis. The following section outlines the background for the chosen method of analysis of the present study, that is, Signal Detection Theory.

Signal Detection Theory

The challenge to the social perceiver when detecting happiness from facial expressions is in many ways a problem consistent with that when confronted with a wide variety of other real-world decision-making tasks. Regardless of whether one is waiting for a telephone to ring, examining an x-ray for indications of disease, or judging smile veracity, to perform these tasks successfully the perceiver must discriminate events that contain the information of interest from those that do not. In fact, this general class of decision problems has been more formally expressed in terms of signal detection theory (Green & Swets, 1966; Tanner & Swets, 1954). Signal detection theory originated from a postgraduate course taught by H. Richard Blackwell at the University of Michigan during the 1940s. Soon after the theory was applied as an approach to study the behaviour of radar operators during the Second World War. At this time radar was a relatively new technology and the fidelity and specificity of the equipment, including the display, was low compared to modern standards. The function of radar was to provide early detection of approaching threats, particularly enemy aircraft, by using high frequency radio waves to determine the position and velocity of objects in the environment. Detected objects would be indicated on the radar display as dots or 'blips'. The task for the radar operator was to decide whether an event on the radar screen indicated an approaching enemy aircraft, or alternatively, was due to some other non-threatening cause such as friendly aircraft, flocks of birds, fishing vessels, or even disturbances in the weather. However, the characteristics of each class of objects (e.g. friendly versus enemy aircraft) were often very similar when represented on a radar screen. The costs of either a false alarm (e.g. scrambling defensive forces upon detection of a fishing boat) or missing approaching enemy craft were high, hence accuracy in reading the radar display was required. The operator needed to be able to reliably distinguish threats from other events based on the limited information available via radar. Statistical decision theory, in the form of Signal Detection Theory was applied by researchers investigating this problem.

Signal Detection Theory, in its traditional form, characterises the task for the perceiver as one that requires differentiation between events containing only 'noise', from events containing a 'signal' embedded in 'noise'. For the purposes of signal detection theory, noise may be defined as information "not designated as a signal, but which may be confused with it" (McNicol, 1972, p.12). Thus, in these terms, a perceiver is confronted with an environmental event with a binary status (i.e. signal or noise) and must make a similarly binary choice regarding this event (i.e. signal is present or not). As displayed in Table 1, there are four possible response-consequence combinations in this scenario: (i) the event contains a signal and is correctly identified as such (a 'hit'), (ii) the event contains a signal, but is not correctly identified (a 'miss'), (iii) the event does not contain a signal and is correctly identified (a 'correct rejection'), and (iv) the event does not contain a signal, but is identified as containing a signal (a 'false alarm').

Table 1: Traditional signal detection matrix

		Response	
		Yes	*No*
Event	*Signal*	Hit	Miss
	Noise	False Alarm	Correct Rejection

For example, someone expecting a telephone call must be able to distinguish the sound of their phone ringing (the signal) from any background commotion (the noise). This task may be relatively simple when in quiet surroundings, but becomes substantially more difficult in a busy office environment where there may be many phones ringing. Indeed, there are four possible outcomes here: (i) the worker's phone rings and they answer it (a 'hit'), (ii) the worker's phone rings and they do not answer it (a 'miss'), (iii) another phone rings and the worker does not answer it (a 'correct rejection') and (iv) another phone rings and the worker answers it (a 'false alarm').

However, as traditionally described, the constructs of signal and noise are somewhat antithetical to a functional ecological approach to psychology. In general, ecological psychologists view all structure in an ambient array as potentially informative to a suitably attuned perceiver. What is critical here, is what such structure is informative *about*, or more specifically what the information specified in the array is *relevant* to (Flach & Warren, 1995; Owen, 1990). Information specified in the ambient array is either relevant to, or not relevant to, a particular affordance property of the environment. Hence, in this sense there is no 'noise' as such, rather, information is deemed to be irrelevant or non-specific to the task at hand. Concomitantly, perceivers can be either attuned or not attuned to this information. Owen has reformulated the traditional signal detection matrix to more accurately reflect the theoretical underpinnings of the ecological approach. As displayed in Table 2, Owen replaced the constructs of 'signal' and 'noise' with the notion of information that is either 'relevant' or 'irrelevant' to the task at hand, while the perceiver is simultaneously represented as either 'attuned' or 'unattuned' to this information.

Table 2: Information specificity matrix (adapted from Owen, 1990)

		Perceiver	
		Attuned	*Nonattuned*
Information	*Specific*	Functional (informative)	Nonfunctional (noninformative)
	Nonspecific	Dysfunctional (misinformative)	Afunctional (uninformative)

Together, these constructs again provide four possible outcomes of the decision task: (i) the perceiver is attuned to task-relevant information such that the actor-environment relationship is deemed *functional* and *informative*, (ii) the perceiver is attuned to information irrelevant to the task at hand such that the actor-environment relationship is deemed *dysfunctional* and *misinformative*, (iii) the perceiver is not attuned to task-relevant information such that the actor-environment relationship is deemed *nonfunctional* and *noninformative* and, (iv) the perceiver is not attuned to (or ignores) information irrelevant to the task such that the actor-environment relationship is deemed *afunctional* and *uninformative*. Clearly this approach provides a more theoretically coherent description of the actor-environment relationship when the assumptions of a functional ecological approach are considered. However, as noted by Flach and Warren, this approach is similar in structure to the general signal detection approach described above, in that the possible states of the environment and those of the perceiver, can be represented as a two-dimensional table. Hence, while the conceptual description provided by Owen is adopted for the present research, the more conventional signal detection approach to calculating sensitivity and bias remains a valid means to estimate these parameters in the present study. This computational approach is described in the following section.

Measuring Sensitivity and Bias

A standard approach to the signal detection task is the yes-no procedure,[40] whereby the participant is presented with information that is either task-relevant or task-irrelevant and must report to which category this information belongs. As applied to the present research, the task for participants is to detect facial expressions of happiness, that is, to distinguish genuine smiles (i.e. task-relevant information) from posed smile and neutral expressions (i.e. task-irrelevant information). This requires that examples of these expressions be presented to participants who must then decide which category they belong to (i.e. an expression of happiness or not). Hence, as described above, there are four possible response-consequence outcomes here: (i) a genuine smile is presented which the perceiver identifies as an expression of happiness (i.e. functional perception or a 'hit'), (ii) a genuine smile is presented which the perceiver does not identify as an expression of happiness (i.e. non-functional perception or a 'miss'), (iii) a posed smile or neutral expression is presented which the perceiver identifies as an expression of happiness (i.e. dysfunctional perception or a 'false alarm'), and (iv) a posed smile or neutral expression is presented which the perceiver does not identify as an expression of happiness (i.e. afunctional perception

[40] Other common forms of the SDT procedure are the forced-choice task and the rating-scale task (for details see (Green & Swets, 1966).

or a 'correct rejection'). From the resultant data, estimates of the hit[41] (H) and false-alarm (F) rates[42] can be obtained, and once standardised, used to calculate independent measures of both sensitivity (d') and bias (c). In regard to sensitivity, if, hypothetically, observers show no ability to discriminate relevant from irrelevant information, then $H \approx F$ and d' will approach 0, while total accuracy (evidenced by a perfect hit rate, and no false alarms) implies an infinite d'.[43] Bias statistics, on the other hand, measure the extent to which observers are simply more willing to choose one option over the other (regardless of the nature of the information being judged), by combining the false alarm and miss rates (essentially the hit rate, as miss rate = 1-hit rate). If no bias is evident $c = 0$, when $c < 0$ a negative bias (tendency to choose 'no' in a yes-no task) is present, and when $c > 0$ a positive bias (tendency to choose 'yes' in a yes-no task) is present. The absolute value of c provides an indication of the magnitude of bias.[44]

Researchers will often manipulate bias by instructing participants to adopt a more (or less) stringent decision criterion.[45] For instance, a participant may be instructed to identify relevant information whenever they suspected such information was present, only when they were certain the information was present, or at some intermediate level of certainty. Adoption of a less stringent decision criterion will essentially lead a participant to be more likely to identify any information as relevant (e.g. respond

[41] Although the terms 'hit' and 'false alarm' are not used by Owen (1990), they are retained for the purposes of the present analyses as they provide a more intuitive description of participants' judgements of the target facial displays.

[42] Estimates of miss rate and correct rejection rate are redundant: miss rate=1-hit rate; correction rejection rate=1-false alarm rate.

[43] In this fashion, sensitivity (d') can be expressed as a value ranging from 0 to infinity, although many researchers consider d' to have an effective ceiling value of 4.65, corresponding to H=0.99 and F=0.01 (Macmillan & Creelman, 1991).

[44] Again, although the range of response bias (c) is theoretically bounded by –infinity to infinity, in practice -2.33 and 2.33 represent the effective lower and upper limits.

[45] Alternatively, it is also common practice to manipulate bias by adjusting the cost/benefit matrix for incorrect and correct decisions respectively.

'yes' in a 'yes-no' procedure) than they might be when using a more stringent decision criterion. Sensitivity should not change under such a manipulation as neither the perceiver's ability to discern relevant from irrelevant information, nor the specificity of the information have changed, only the manner in which the decision is made has been impacted. Varying the decision criterion (in effect bias) will, in theory, impact on both the hit and false alarm rates so that sensitivity remains relatively constant. For instance, a lax criterion may result in a high hit rate, but at the expense of a high false alarm rate, while with a more conservative criterion the opposite would be expected, that is, a lower hit rate, but also fewer false alarms. Thus, by varying the nature of the decision criterion, researchers are able to generate more accurate estimates of sensitivity over a range of levels of bias.

In general, the signal detection theory approach to perceptual decision making has the advantage of providing standardised estimates of both the sensitivity and bias of observers when attempting to discriminate between task relevant and task irrelevant information. By varying the decision criteria employed by participants from more to less conservative (or vice-versa) an accurate assessment of the ability of the observer to determine the relevance of information, or in this case, to determine whether a given facial expression specifies happiness, can be obtained. Thus, this approach will be adopted within the present research to investigate the ability of perceivers to distinguish posed from genuine smiles. In remaining consistent with the notion that perceivers should be sensitive to underlying emotional state specified by physiognomy, participants will be required to identify facial displays specifying happiness using two separate decision criteria: specifically whether the individual is *showing* happiness, a relatively lax criterion, or whether the individual is *feeling* happiness, a relatively conservative criterion. Although only genuine smiles specify happiness regardless of whether the emotion shown, or the emotion felt, is being judged, it is expected that participants will exhibit a greater degree of bias, that is, to be more likely to classify a posed smile as reflecting happiness when judging the emotion shown compared to the emotion felt. It is suggested that the morphological similarities between posed and genuine smiles may lead perceivers to be more likely to consider any smile to be indicative of an individual showing happiness, in comparison to judgments of the emotion felt, whereby, only genuine smiles would be likely to be equated with feeling happy.

Thus, the present research was intended to examine the sensitivity of perceivers to the presence of positive affect as specified by the physiognomic differences between posed and genuine smiles using a signal detection procedure. Two experiments are reported, the first uses static photographs of facial displays, and the second employs dynamic displays presented via video.

Experiment 1a

This experiment involved showing participants photographs of a variety of individuals exhibiting a range of facial expressions (neutral expressions, posed smiles and genuine smiles) and asking them to simply judge whether the individual in the photograph was happy or not. The approach of requiring participants to judge emotional state directly, as opposed to identifying 'social' and 'enjoyment' smiles as required by Frank et al. (1993), or any other descriptor of smile veracity such as posed and genuine, fake and authentic, intentional and spontaneous, was adopted for a number of reasons. First, emotional state was the phenomenon of interest. As has been suggested, it is the underlying emotional state that structures the information available to perceivers, and in turn provides consequences for action. The morphology of the facial expressions in question is potentially arbitrary until consideration is given to the ontology of the expression, that is, whether a given smile occurs in the presence or absence of a positive emotional state. In short, it is the underlying emotional state accompanying a smile, not the structural qualities of the facial expression, that the perceiver needs to be sensitive to, as it is this same emotional state that has consequences for the perceiver. Second, a direct description of the variable to be judged (i.e. positive emotional state) minimises the potential for misunderstanding and misinterpretation by participants that may occur with less direct accounts. Describing an individual's smile as a genuine smile or an enjoyment smile, for instance, may not necessarily reflect perceived smile veracity, but instead may describe perceived characteristics of the individual being judged (e.g. a 'genuine-looking' person may be expected to exhibit a genuine smile). Even careful briefing of participants as to the definitions of the smile types to be judged provides no guarantee these will be adhered to. Third, judging smiles as posed or genuine may be influenced by a social-desirability response bias. Describing another person as being deceptive or faking involves a negative evaluation of that person, an activity that is counter to the generally positive biases reported to accompany the formation of initial interpersonal impressions (Miller & Felicio, 1990). As such, judges may simply be less likely to identify a given smile as fake or posed, than the less socially-valued distinction of that individual not experiencing or exhibiting happiness, that is, the affordance-relevant property that is of interest here. Although signal detection analysis provides a measure of bias, it is preferable not to introduce such artefacts by means of the experimental procedure employed. Finally, the use of the binary distinction, happy versus not happy, allows for the use of a forced-choice response format, without requiring a 'none of these is correct' option. In regard to emotional state, an individual is either happy or not happy, there is no sensible intermediate category or alternative.

In addition to requiring participants to judge emotional state directly, in the present study separate judgements were required with regard to the emotion the target individual was showing (happy or not happy), and the emotion they were feeling (happy or not happy). As described, this manipulation was, in effect, an attempt to vary the decision criterion used by participants. In the context of the present study, judging whether an emotion is shown on an individual's face is likely to lead to a less conservative decision strategy compared to judging whether that individual is actually feeling an emotion. While both decisions are explicitly about the presence or absence of emotional state, the morphology of a posed smile, and its resemblance to that of a genuine smile, may lead to these expressions being more readily classified as an individual showing happiness than that individual feeling happy. However, happiness, whether shown or felt, does not accompany posed smiles. Hence the hypothesised adoption of a relatively lax decision criterion when judging the emotion shown is likely to be reflected in estimates of bias rather than a categorical change in the perception of what is being judged.

In keeping with the adaptive, functional nature of social perception advocated by proponents of the ecological approach to psychology (e.g. Gibson, 1979; McArthur & Baron, 1983) a number of specific predictions can be made in regard to the present experiment. Firstly, as has been outlined in previous chapters, it appears that it is important for the social perceiver to be sensitive to the emotional state of others.

Accordingly, it is predicted that participants will display sensitivity to the presence of happiness as specified by facial expression. Furthermore, it is potentially disadvantageous to exhibit a bias toward identifying any given smile as indicating happiness, because errors are likely to lead to an individual misperceiving opportunities for action and interaction. Therefore, it is predicted that the overall level of response bias will be low (i.e. will not differ from 0). However, in accordance with the manipulation of the decision criterion, the level of bias is predicted to differ between the showing and feeling judgement conditions, such that less bias will be evident when making judgements of the emotion felt by the target individual.

Method

Participants.

Participants in Experiment 1a were 17 female[46] students recruited from the University of Canterbury. They ranged in age from 17 years to 45 years ($M = 21.7$ years, $SD = 6.1$). Each participant was given a $2 scratch-and-win lottery ticket upon completion of the procedure.

Facial displays.

Three facial expressions (a neutral expression and two smiles) were selected from 12[47] of the 13 individuals who participated in the facial display generation procedure described in the previous chapter. Both male ($n = 4$) and female ($n = 8$) facial displays were included to enable comparison of sensitivity to emotional state between

[46] Ambady, Hallahan and Rosenthal (Ambady, Hallahan, & Rosenthal, 1995) reported that females were more accurate judges of nonverbal behaviour in strangers than males. Hence, only female participants were included in the present study in order to maximise the power of the current design without needing to include participant sex as a factor thereby increasing the required sample size.
[47] One participant's facial displays were not included in the current experiments as no complete set of expressions required for this task (i.e. one posed and one genuine smile, or one closed mouth and one open mouth smile) was available.

male and female targets, and to ensure that all facial displays available were employed in the present procedure.[48] An attempt was made to ensure that both smiles from each individual were matched for intensity in terms of FACS criteria for expression intensity[49]. For each of the 9 individuals from whom a full set of smiles was available, a genuine smile was selected. A posed smile from the same individual was then selected to match their genuine smile in terms of expression intensity. Four of the genuine smiles consisted simply of AU6 (contraction of *orbicularis oculi*) and AU12 (contraction of *zygomatic major*), and hence were considered prototypical genuine smiles respectively. For the 5 remaining genuine smiles the front teeth of the respective individual were visible during the smile. Depending on individual differences of facial physiognomy, exposure of the teeth may simply be the result of AU12 contraction or alternatively may be due to the additional action units (e.g. AU25 – contraction of the lip separator muscle) involved in widening and separating the lips during the smile and exposing the teeth[50]. One study is known to have investigated the influence of the exposure of the teeth during a smile on perceptions of happiness. Otta, Abrsio and Hoshino (1996) reported that perceivers rated smiles where the teeth were exposed as reflecting a greater level of happiness than smiles that did not expose the teeth.[51] Thus, this factor needs to be taken into account in the present study. Therefore, genuine smiles with teeth exposed were matched with posed

[48] Unfortunately, there were not sufficient male facial displays to have an equal number of male and female targets in the present study.

[49] FACS provides conventions for scoring the intensity of each action unit ranging from 'A' indicating a trace of the action is present to 'E' indicating the maximum level of contraction is evident. Where expressions were matched for intensity, both expressions were rated at the same level of intensity using the FACS criteria.

[50] Ekman, in a commentary on Darwin (1872/1998), noted that "the zygomatic major muscle stretches the upper lip and in most people this also raises the lip" (p. 201).

[51] Additionally, Owen (1988) reported that participants who exposed their teeth while smiling in response to a cartoon, rated these cartoons as more funny than those to which they smiled at but did not expose their teeth. This indicates that the exposure of the teeth during a smile may actually be related to intensity of experienced positive emotion, as well as being perceived in this manner (e.g. Otta et al., 1996).

smiles also exposing the teeth. These groups of 4 (2 males) and 5 (1 male) individuals respectively are referred to as the 'closed mouth smile' and 'open mouth smile' groups. For the remaining 3 individuals (1 male) for whom no genuine smiles were obtained, two posed smiles were selected, one with the teeth exposed and one without. By including these smiles, as well as the neutral expressions, essentially increases the number of judgement trials, thereby increasing the precision of the resultant estimates of sensitivity and bias. Furthermore, the inclusion of neutral expressions and additional posed smiles served to enhance the ecological validity of the procedure by introducing a distribution of genuine smiles to other expressions that did not conform to a general 50/50 split that may be expected in such judgement studies, but is unlikely to be encountered during ordinary social interaction.

To ensure that the facial displays selected for use in the present study were reliably coded as posed or genuine smiles, each expression was coded by another individual familiar with FACS coding. This revealed an agreement rate between coders of 100%.

All facial displays were digitally standardised for brightness and contrast using Adobe Photoshop, and presented as full colour, 640x480-pixel, bitmap images.

Design.

A 3 (Facial expression: Neutral / Posed smile / Genuine smile) x 2 (Smile type: Closed mouth / Open mouth) x 2 (Judgement type: Show / Feel) within-participants design was employed for Experiment 1a. Order of presentation of facial expression and facial expression sex was randomised for each participant while order of judgement type was counterbalanced. Facial expression sex was not included in the current design as only 1 set of male open mouth smile facial displays were available and therefore there was insufficient data in this cell to enable a valid comparison.

Apparatus.

Facial displays were presented on a 17-inch colour computer monitor using custom written software (Walton, 2003a) and a PIII 650mhz personal computer running Windows XP Professional.

Procedure.

Participants were invited to take part in an experiment that was described as investigating factors related to the way people form impressions from faces. They were provided with an information sheet (see Appendix F) that outlined their rights and obligations as a participant, and provided a brief description of the research. In this description, attention was drawn to notions of both the experience and expression of emotion. Each participant then signed a consent form (see Appendix G), was ushered into a separate testing room and seated approximately 60cm from a computer monitor. They were told they would be seeing a series of photographs of different individuals on a computer screen and that their task was simply to judge whether the person in the photograph was happy or not. It was explained that they would be performing the procedure twice; once judging what emotion the person was showing, and once judging what emotion the person was feeling. The experimenter queried the participant as to their understanding of the instructions and clarified any matters that arose. If the participant sought clarification regarding the distinction between showing and feeling judgements, the experimenter referred to the concepts of the experience and expression of emotion described in the information sheet. The order of judgement type was counterbalanced across participants. The instructions for the task were presented again on the computer screen along with information regarding which key to press to indicate 'happy' or 'not happy' respectively. The word 'showing' (or 'feeling' depending on condition) was emphasised in capitals throughout these instructions.

The task began with a practice judgement trial observed by the experimenter. A photograph[52] was presented on the screen until the participant responded (happy or not happy) with a key press.[53] If the experimenter was satisfied that the participant was familiar with the judgement task, the procedure was advanced to the actual judgement trials using the facial displays described above. During these trials the participant was left alone in the testing room and photograph presentation order was randomised. On each trial, once the participant had responded, the photograph was immediately replaced by the next in the sequence. After the participant had made judgements of all 36 facial displays the judgement condition (i.e. showing or feeling) was changed by the experimenter and the procedure repeated. Finally, participants were debriefed as to the purpose of the experiment and thanked. The entire procedure lasted approximately 15-20 minutes.

Data analysis.

As described earlier in this chapter, sensitivity to the difference between posed and genuine smiles, and any associated response bias, was assessed by means of a signal detection analysis. Specifically, a non-parametric approach to computing sensitivity and bias was adopted for the present analysis (see Appendix H for formulae). This

[52] A photograph of a posed smile from the individual who was not included in the facial display set used for this study served as the practice trial facial display.

[53] The present design therefore is equivalent to a standard yes-no signal detection task.

approach provides the researcher with accurate estimates of sensitivity (*A'*) and response bias (*B"*) for tasks where there is little basis for expecting any particular pattern of responses (Green & Swets, 1966). A distribution-free approach, such as this one, does not require any assumptions regarding the nature of the underlying decision process (Snodgrass & Corwin, 1988). Given that the alternative approaches to the calculation of sensitivity and bias involve assumptions pertinent to the dominant cognitive models of detection and recognition, most of which are not conducive to the ecological approach to perception, it is preferable to adopt an approach that does not commit to these assumptions. In this sense, the dearth of empirical literature relevant to the detectability of posed and genuine smiles further precludes any a priori theorising as to the nature of the process underlying the decision to classify a given facial expression as a posed or genuine smile. Although the non-parametric approach to measuring sensitivity and bias has been shown to asymptote at very high levels of performance[54] (Snodgrass & Corwin, 1988), at intermediate performance levels *A'* and *B"* provide an acceptable alternative to *d'* and *c* (Macmillan & Creelman, 1991). Considering that emotion recognition studies in general very rarely report levels of performance that approach complete accuracy (Elfenbein & Ambady, 2002), let alone when distinguishing between veridical and non-veridical versions of the same expression, this limitation of the non-parametric approach to signal detection appears reasonable in light of the nature of the present research.

Results

Data from each participant were collated into hits and false alarms separately for each facial expression and judgement condition. A hit was defined as correctly identifying

[54] In practice, if the hit rate = 0.99 and the false alarm rate = 0.01, *A'* asymptotes at approximately 1.00 hence this value should be considered the effective ceiling for *A'*.

a genuine smile as 'happy', while a false alarm was defined as identifying either a neutral expression or a posed smile as 'happy'. The percentage of expressions categorised as 'happy' as a function of expression type and judgement condition are displayed in Table 3. A visual inspection of these data suggest that smiles were more likely to have been classified as 'happy' when judging the emotion shown compared with the emotion felt as the majority of posed smiles were judged as reflecting happiness when judging the emotion shown, but not when judging the emotion felt. However, the majority of genuine smiles were classified as reflecting happiness regardless of presentation or judgment condition. Smiles with the teeth exposed (i.e. open mouth smiles) were more likely to have been classified as reflecting happiness than those without the teeth exposed, independent of smile veracity or judgment condition. Thus, at a descriptive level, there is some preliminary support for the hypothesised effects. It appears that participants were able to correctly attribute genuine, but not posed, smiles as reflecting happiness when judging the emotion felt by the target individual.

Table 3:
Percentage facial displays categorised as HAPPY by judgment condition and facial expression for Experiment 1a.

	Judgement Condition		
Facial expression	*SHOW* (*% happy*)	*FEEL* (*% happy*)	*TOTAL* (*% happy*)
Neutral expression	1%	6%	*4%*
Posed smile (closed mouth)	80%	47%	*63%*
Posed smile (open mouth)	97%	62%	*79%*
Genuine smile (closed mouth)	96%	81%	*88%*
Genuine smile (open mouth)	100%	98%	*99%*
Total	*62%*	*48%*	*55%*

The frequency of hits and false alarms were converted to the associated rates of hits and false alarms by applying a correction recommended by Snodgrass and Corwin (1988).[55] The resulting hit and false alarm rates were used to calculate measures of sensitivity (*A'*) and bias (*B''*) by judgement condition for each participant using a non-parametric approach (see Appendix H). The hit and false alarm rates as well as the estimates of *A'* and *B''* are displayed in Table 4.

Table 4:
Mean hit (HIT) and false alarm (FA) rates, and estimates of sensitivity (A') and bias (B'') by judgment condition and smile type for Experiment 1a.

Judgement condition	*HIT*	*FA*	*A'*	*B''*
'Show' judgements				
Closed mouth smiles	0.86	0.30	0.86	-0.33
Open mouth smiles	0.91	0.40	0.86	-0.52
'Feel' judgements				
Closed mouth smiles	0.75	0.19	0.86	0.06*
Open mouth smiles	0.90	0.30	0.88	-0.32

Note: Means with a * do not significantly differ from 0 ($p > 0.05$) using a single sample t-test.

Sensitivity

Mean estimates of *A'* were computed separately for the 'showing' and the 'feeling' judgement conditions and compared using repeated measures analysis of variance. As can be seen in Table 4, the level of sensitivity observed across all judgement conditions and target types was consistently in the range of 0.86-0.88, indicating that

[55] When the hit rate = 1 or the false alarm rate = 0, SDT analysis is not possible (values approach ∞), hence Snodgrass and Corwin (1988) suggest routinely applying a correction formula to all data of this nature to permit calculation, e.g. hit rate = (#hits + 0.5) / (# relevant trials +1).

participants could reliably detect happiness from facial expression.[56] A 2 (smile type: closed mouth / open mouth) x 2 (judgement condition: show / feel) repeated measures ANOVA was conducted to assess the impact of the smile type and judgement condition (i.e. showing or feeling) on participant sensitivity to happiness as specified by facial expression. This revealed no significant effects indicating that sensitivity was consistent across all conditions.

Bias

The mean estimates of *B"* are shown in Table 4 by smile type and judgement condition.[57] As can be seen, the level of bias exhibited by participants appears to vary between judgement conditions, with a tendency toward a greater likelihood to responding 'happy' when judging the emotion shown, compared to the emotion felt.[58] To examine this effect more closely, a 2 (smile type: closed mouth / open mouth) x 2 (judgement condition: show / feel) repeated measures ANOVA was conducted. This revealed that judgments of closed mouth smiles ($M_{B''} = -0.14$) were less biased than judgments of open mouth smiles ($M_{B''} = -0.42$), $F(1,16) = 40.68, p < 0.01$. Examination of the percentage of expressions classified as 'happy' shown in Table 3 suggests that participants were more likely to classify an open mouth smile as happy than a closed mouth smile regardless of smile veracity or judgment condition. Furthermore, judgments of the emotion shown ($M_{B''} = -0.42$) were more biased than

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[56] For each condition, a single sample one-tailed t-test was used to compare the obtained value of *A'* with 0 (representing no sensitivity). All the t-tests revealed that the obtained *A'* was significantly different from 0, thereby indicating participants were indeed sensitive to happiness as specified by facial expression across all conditions.
[57] As stated above, the absolute value of *B"* indicates the magnitude of bias observed. Hence, bias scores can be interpreted in the same manner as correlation coefficients: the distance from 0 indicates the degree of bias, while the direction from 0 (i.e. a negative or positive value) indicates the direction of the bias.
[58] For each condition, a single sample one-tailed t-test was used to compare the obtained value of *B"* with 0 (representing no response bias). Only 'feel' judgments of closed mouth smiles did not exhibit any significant response bias.

judgments of the emotion felt ($M_{B''}$ = -0.13), $F(1,16) = 14.21, p < 0.01$. An examination of Table 3 suggests that participants were more likely to categorise any expression as 'happy' when judging the emotion shown compared with the emotion felt.

These effects were qualified by a significant interaction between smile type and judgment condition, $F(1,16) = 6.50, p < 0.05$. As can be seen in Figure 2, judgments of the emotion felt when viewing closed mouth smiles were the least biased ($M_{B''}$ = 0.06). When viewing open mouth smiles and judging the emotion felt ($M_{B''}$ = -0.32), or judging the emotion shown by either closed mouth smile displays ($M_{B''}$ = -0.33) or open mouth smile displays ($M_{B''}$ = -0.52), significantly more bias was exhibited by participants, (Tukey a, $p < 0.05$).

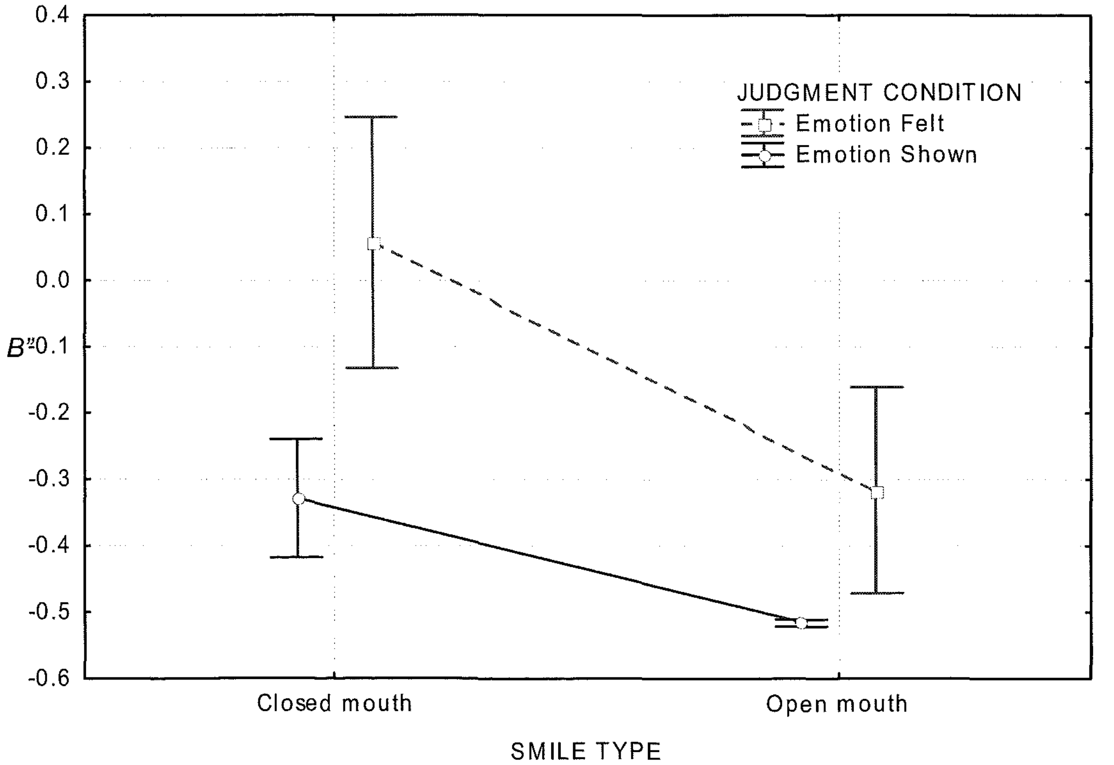

Figure 2: Line graph of interaction between smile type and judgment condition for mean estimates of bias (B") for Experiment 1a.

No difference in bias was revealed between judgments of the emotion shown when viewing closed mouth smiles and the emotion felt when viewing open mouth smiles (Tukey *a*, n.s.), while judgments of the emotion shown when viewing open mouth smiles were accompanied by significantly more bias than any of the other conditions (Tukey *a*, $p < 0.05$).

Discussion

As predicted, the participants in Experiment 1a revealed a very consistent level of sensitivity to happiness as specified by facial expression. Regardless of whether judgements were made on the basis of whether closed or open mouth smiles were being judged, or whether the emotion the target was showing or feeling was being judged, participants were able to detect information specifying positive affect from facial expressions. Also as anticipated, underlying these judgements were clear shifts in bias related to the nature of the judgement undertaken as well as the nature of the facial expression being judged. When judging the emotion shown, participants simply tended to be more likely to respond 'happy'. Furthermore, judgments of closed mouth smiles were accompanied by less bias than those of open mouth smiles.

Thus, the data from Experiment 1a appear to support the prediction that perceivers would be able to reliably detect the presence or absence of a positive emotional state from judgments of facial expressions. The level of sensitivity displayed by participants to information specifying happiness was consistent across all conditions indicating that the participants in this study were identifying emotional state in a systematic manner. Regardless of decision strategy or the nature of the facial displays being judged, participants demonstrated a propensity to associate happiness with genuine smiles. The nature of the bias observed did, however, vary across judgement condition (i.e. show / feel) and target group (i.e. closed mouth / open mouth smiles). The differences in bias between the showing and feeling judgement conditions were in line with the intended shift in decision criterion. When judging the emotion shown, participants adopted a more lax decision criterion than when judging the emotion felt, resulting in a tendency to more readily identify expressions not specifying positive affect as 'happy'. It is likely that this effect was due to a trend to consider any smile, regardless of veracity, a display of happiness when considering the emotion shown by an individual. Furthermore, open mouth smiles where the teeth were visible tended to be categorised as 'happy' more frequently than closed mouth smiles regardless of smile veracity or judgement condition. This suggests that exposure of the teeth in the context of a smile-like expression resembles an expression of happiness more so than an equivalent closed mouth smile. In other words, in open mouth smiles, there is a less clear distinction between relevant and irrelevant information such that there is a greater tendency for false alarms when viewing open mouth posed smiles. On the other hand, for closed mouth smiles, the information relevant to a specification of happiness is somewhat amplified in the absence of the irrelevant information specified by the exposed teeth. Consistent with the suggestion posited by Frank et al., (1993) that in terms of smile veracity, judgment accuracy can be enhanced under ideal conditions, the present data suggest that the emotional state of targets exhibiting closed mouth smiles is judged more accurately.

The theoretical underpinnings for the levels of bias observed in the present study warrant further attention here. Broadly speaking, it appears as though the effects revealed with regard to bias are the result of two quite distinct sources of influence.

The effect of the smile type (i.e. closed or open mouth) judgment condition is clearly linked to the nature of the facial displays employed, that is, this is an information-based influence. Alternatively, the effect for judgment condition derives from the instructions provided to participants. Tentatively, it is suggested that this effect appears to be due to different motivational bases for deciding which expressions reflect happiness and which do not. Kahneman (1973) has differentiated between different sources of bias likely to influence decision-making tasks such as that required in the present research. More specifically, Kahneman suggested that *perceptual readiness* and *response readiness* can be considered to be distinct, but related, sources of bias when performing judgment tasks. Perceptual readiness refers to the likelihood that a perceiver will select a specific interpretation of the information they are presented with. For instance, Kahneman provides an illustration of perceptual readiness with regard to the Ames distorted room,[59] an environment constructed such that from a perceiver's viewpoint it appears rectangular (as a normal room would appear), but in fact is distorted. The issue here is that, from the specified viewpoint of the perceiver, there is no information that differentiates the distorted room from a regular room, yet perceivers unanimously see it as rectangular, not distorted. In this sense, perceivers are simply more likely to provide an interpretation of the information they are presented that is consistent with a prior expectation or experience (after all, environments such as the Ames distorted room are rarely encountered in normal day-to-day activity). That is, they are 'ready' to interpret ambiguous information in a manner consistent with the meaning given to similar, but unambiguous, information. Applied to the present research, it is suggested that the tendency of participants to be more likely to identify open mouth in comparison to

[59] Named after its inventor, Adelbert Ames.

closed mouth smiles as reflecting happiness, regardless of veracity, reflects an influence of perceptual readiness on bias in that the variability of judgments was directly related to the information available for acquisition rather than any motivational factors. The exposure of the teeth in the context of a smile, although ambiguous with regard to the veracity of the smile, was readily interpreted to reflect a positive emotional state. When this information was present, participants adopted a more lax criterion for identifying happiness resulting in posed smiles (with the teeth exposed) being incorrectly classified as 'happy'.

Alternatively, response readiness reflects the likelihood of participants to select a particular response, again independent of the information present. Kahneman (1973) provides the example of a participant in a tachistoscope procedure who, although correctly identifies the word 'whore' when presented very briefly, reports seeing 'whole', "lest his mind be thought dirty" (p.94). It is proposed that in the present research, the difference in bias revealed between judgments of the emotion shown and the emotion felt, was due to an effect of response readiness. Participants, potentially due to motivational factors associated with the judgment condition, were more willing to identify any facial expression, regardless of veracity, as reflecting happiness when judging the emotion shown compared to the emotion felt. Thus, it is assumed that in the present study, participants adopted a more lax criterion when judging the emotion shown. As a result, more posed smiles were identified as 'happy' than when the emotion felt was being judged.

Finally, it should be noted that judgements made in this experiment were of static photographs while which, although having the ability to present clearly prototypic facial displays, may suffer from a lack of generalisability from the experimental procedure to actual social interaction, where we ordinarily see dynamically changing facial expressions. Therefore, the next experiment in this study was intended as a means to enhance the ecological validity of the present research by introducing dynamically presented facial displays.

Experiment 1b

This experiment was essentially a replication of Experiment 1a, but with the facial displays presented dynamically using video rather than the static photographs, which were used in the previous experiment. The incorporation of dynamic facial expressions of emotion is an important addition to the current research. As discussed, proponents of the ecological approach to psychology advocate that information is best revealed in events; dynamic, temporally distributed transformations of objects in the environment. In regard to facial expressions of emotion, this view has received some support in the literature with Fridja (1953) and Harwood, Hall and Shinkfield (1999) reporting evidence for superior recognition of emotional state when viewing dynamic, as opposed to static facial expressions. The use of dynamic facial displays also offers a greater level of ecological validity to the present research. In general, facial expressions of emotion encountered during actual social interactions are dynamic, a property that needs to be preserved in laboratory-based research if the generalisability of results from the laboratory to the real world, is a desirable outcome. Thus, in light of the results of past research and the previous experiment, it is predicted that perceivers will be more sensitive to expressions of happiness when viewing dynamic compared to static representations of these facial displays. Further, it is also predicted that with the exception of overall sensitivity, the pattern of results obtained for Experiment 1a will be consistent with that of the present experiment.

Method

Participants.

Participants in Experiment 1b were 20 female students recruited from the University of Canterbury who had not participated in Experiment 1a. They ranged in age from 17 to 39 years (*M* = 22.4 years, *SD* = 5.6). Upon completion of the procedure each participant was given a $5 voucher redeemable at campus stores.

Facial displays.

The static facial displays employed in Experiment 1a were sourced from the video-clips produced from the facial display generation procedure described in the previous chapter. To ensure consistency and comparability between Experiments 1a and 1b, the source video clips were used as the facial displays judged in the present experiment. The clips varied in duration between 9 and 10.5 seconds and were edited to include the onset, apex, and offset of the facial expression in question. The neutral facial expression clips did not include a beginning or end to the expression, but instead simply featured a relatively constant, expressionless face. In all other respects, including the groupings of closed and open mouth smiles, the facial displays used in the present experiment were identical to those employed in Experiment 1a.

To ensure that the facial displays selected for use in the present study were reliably coded as posed or genuine smiles, each expression was coded by another individual familiar with FACS coding. Initially this revealed an agreement rate of 87.2%, however, after discussion, agreement was reached on all expressions.

All facial displays were digitally standardised for brightness and contrast using Adobe Premier software, compressed using a Microsoft MPEG4 V2 codec, and presented as full colour, 720x576 pixel, PAL video images displayed at 25 frames per second.

Procedure.

The procedure employed for the present experiment was identical to that of Experiment 1a with one exception. Participants were instructed to wait until each video clip had finished (i.e. when the screen went blank) before they made their judgement. The entire procedure took approximately 30 minutes due to viewing time of the facial display videos being longer that that required for the static photograph displays employed in Experiment 1a.

The experimental design, apparatus, and data analysis employed for the present experiment were identical to those employed in Experiment 1a.

Results

As for Experiment 1a, data from each participant were collated into hits and false alarms separately for each judgement condition. Table 5 displays the percentage of expressions categorised as 'happy' as a function of expression type and judgment condition. Inspection of these data suggest that, consistent with Experiment 1a, smiles with the teeth exposed were more likely to be classified as 'happy' regardless of veracity, as were judgments of all expressions when the emotion shown, rather than the emotion felt, was being judged. Again, at this descriptive level, there appears to be support for the prediction that when viewing videos of facial expressions, participants were able to accurately identify happiness, particularly when judging the emotion felt by the target individual.

Table 5:
Percentage facial displays categorised as HAPPY by judgment condition and facial expression for Experiment 1b.

	Judgement Condition		
	SHOW	*FEEL*	*TOTAL*
Facial expression	*(% happy)*	*(% happy)*	*(% happy)*
Neutral expression	5%	7%	*6%*
Posed smile (closed mouth)	86%	39%	*63%*
Posed smile (open mouth)	81%	39%	*60%*
Genuine smile (closed mouth)	89%	80%	*84%*
Genuine smile (open mouth)	94%	88%	*91%*
Total	*59%*	*40%*	*50%*

The frequency of hits and false alarms were again converted to the associated rates of hits and false alarms by applying a correction recommended by Snodgrass and Corwin (1988). The resulting hit and false alarm rates were used to calculate measures of sensitivity (*A'*) and bias (*B"*) by judgement condition for each participant using a non-parametric approach (see Appendix H). The hit and false alarm rates as well as the estimates of *A'* and *B"* for Experiment 1b are displayed in Table 6.

Sensitivity

Mean estimates of *A'* were computed separately for the 'showing' and the 'feeling' judgement conditions and compared using repeated measures analysis of variance. As can be seen in Table 6, the level of sensitivity observed across all judgement conditions and target types was consistently in the range 0.83-0.85[60], indicating that participants could reliably detect happiness when the facial displays were presented dynamically. A 2 (smile type: closed mouth / open mouth) x 2 (judgement condition: show / feel) repeated measures ANOVA was conducted to assess the impact of the smile type and judgement condition on participant sensitivity to happiness as specified by facial expression. When judging from video, participants were more sensitive to happiness specified by facial expression when judging the emotion felt ($M_{A'} = 0.87$) than when judging the emotion shown ($M_{A'} = 0.84$), $F(1,19) = 7.60$, $p < 0.01$. No significant effect was revealed for smile type (i.e. closed versus open mouth), nor was there any interaction between judgment condition and smile type.

Table 6:
Mean hit (HIT) and false alarm (FA) rates, and estimates of sensitivity (A') and bias (B") by judgment condition and smile type for Experiment 1b.

Judgement condition	*HIT*	*FA*	*A'*	*B"*
'Show' judgements				
Closed mouth smiles	0.81	0.33	0.83	-0.24
Open mouth smiles	0.88	0.37	0.85	-0.44
'Feel' judgements				
Closed mouth smiles	0.74	0.16	0.87	0.11*
Open mouth smiles	0.82	0.22	0.87	-0.12*

Note: Means with a * do not significantly differ from 0 ($p > 0.05$) using a single sample one-tailed t-test.

[60] For each condition, a single sample t-test was used to compare the obtained value of *A'* with 0 (representing no sensitivity). All the t-tests revealed that the obtained *A'* was significantly different from 0, thereby indicating participants were indeed sensitive to happiness as specified by facial expression across all conditions.

Bias

The mean estimates of B'' for judgements of the dynamically presented facial displays are shown in Table 6 by smile type and judgement condition. As can be seen, again the level of response bias exhibited by participants appears to vary between judgement condition, with a tendency toward a greater likelihood to responding 'happy' when judging the emotion shown, compared to the emotion felt.[61] To examine this effect more closely, a 2 (smile type: closed mouth / open mouth) x 2 (judgement condition: show / feel) repeated measures ANOVA was conducted. Judgments of closed mouth smiles ($M_{B''} = -0.07$) were less biased that judgments of open mouth smiles ($M_{B''} = -0.26$), $F(1,19) = 22.55, p < 0.01$. Furthermore, judgments of the emotion shown ($M_{B''} = -0.33$) were accompanied by more bias than judgments of the emotion felt ($M_{B''} = 0.00$), $F(1,19) = 21.03, p < 0.01$. No significant interaction effect was revealed.

Discussion

The pattern of results revealed in the present study closely resembled that found in Experiment 1a. Participants consistently demonstrated an ability to detect the presence of positive affect from dynamic facial expressions. In addition, in the present experiment, when participants were judging the emotion felt from dynamically presented facial displays they exhibited more sensitivity to information specifying positive affect than when judging the emotion shown. Again, as found for the previous experiment, underlying these judgements were systematic changes in bias. Specifically, in the present study participants demonstrated a tendency to be more likely to identify any given expression as 'happy' when judging the emotion shown

[61] For each condition, a single sample t-test was used to compare the obtained value of B'' with 0 (representing no response bias). For 'feel' judgments of both closed and open mouth smiles no significant response bias was exhibited.

compared to the emotion felt. Furthermore, judgements of targets displaying closed mouth smiles were less biased than judgements of open mouth smiles. These results mirror closely those reported for Experiment 1a.

Overall, Experiment 1b can be seen to replicate the findings of the previous experiment in that participants demonstrated a consistent ability to identify the presence or absence of positive emotional state from facial expressions. The additional finding that when judging the emotion felt participants were more sensitive to information specifying happiness than when judging the emotion shown reflects the lower rate of false alarms for the feeling ($FA_{feel} = 0.19$) compared to the showing ($FA_{show} = 0.35$) judgment condition (see Table 6). Participants were more likely to correctly categorise a posed smile as 'not happy' when judging the emotion felt. Furthermore, the effects of smile type and judgment condition on bias were also consistent between Experiments 1a and 1b. Specifically, consistent with Kahneman's (1973) notion of perceptual readiness, participants were more willing to categorise a smile that exposed the teeth as happy than a smile that did not expose the teeth. Participants were also more likely to consider any expression as reflecting happiness when judging the emotion shown compared with the emotion felt. Hence, overall the results of Experiments 1a and 1b suggest that perceivers can distinguish between facial expressions that do and do not specify happiness.

Comparison Between Experiments 1a and 1b

Additional analyses were conducted to compare the observed levels of sensitivity and response bias between the static and dynamic modes of facial display presentation (i.e. Experiments 1a and 1b). Although these experiments were conducted separately, efforts were made to ensure that they were identical in respect to method and procedure, with the exception of mode of presentation, to permit direct statistical comparison. Importantly, as described above, the static facial displays used in Experiment 1a were sourced from the dynamic displays used in Experiment 1b as the use of distinct facial displays would limit the comparability between the two studies.

Sensitivity.

A 2 (presentation mode: static / dynamic) x 2 (smile type: closed mouth / open mouth) x 2 (judgement condition: show / feel) ANOVA with repeated measures on the second and third factors was conducted to compare sensitivity across presentation modes. No significant effect was revealed for presentation mode, $F\,(1,35) = 1.19, p = 0.28$, indicating that overall, there was no difference in sensitivity to information specifying happiness when the facial displays were presented as static photographs compared to when the same facial displays were presented dynamically using video. Furthermore, there were no significant interactions between presentation mode and smile type or judgment condition.

Bias.

A 2 (presentation mode: static / dynamic) x 2 (smile type: closed mouth / open mouth) x 2 (judgement condition: show / feel) ANOVA with repeated measures on the second and third factors was conducted to compare bias across presentation modes. This revealed a main effect for presentation mode, $F\,(1,35) = 5.46, p < 0.05$. A comparison of the mean level of bias for each respective presentation condition (see Tables 4 and 6) revealed that judgments made from photographs ($M_{B''} = -0.28$) were accompanied by more bias than judgments made from videos ($M_{B''}$ = -0.17). No interactions between presentation mode and smile type or judgment condition were revealed.

In regard to the comparison between Experiments 1a and 1b, that is statically and dynamically presented facial displays, the prediction that dynamic presentation would result in an enhanced ability to distinguish posed from genuine smiles was not supported. No difference in sensitivity was observed between Experiments 1a and 1b. However, response bias was shown to differ between the two experiments. Participants judging happiness from dynamically presented facial expressions exhibited less response bias than those viewing the expressions presented as static photographs.

General Discussion

The present study was intended to replicate and extend the research reported by Frank et al. (1993) concerning perceiver sensitivity to the presence of positive affect as specified by facial expression. A number of methodological improvements were made compared to the experimental procedure employed by Frank et al., including using a specially constructed set of ecologically valid facial displays (see Chapter 3 for details), adapting the testing conditions to more closely resemble actual social interactions by requiring participants to detect emotional state rather than judge smile veracity, and adopting a signal-detection approach to the experimental design and analysis of results.

The results from the present study suggest that perceivers were able to reliably detect the presence or absence of a positive emotional state when viewing both static and dynamic facial expressions. This effect is in line with the theoretical arguments for the functionality of such sensitivity for the social perceiver as outlined in earlier chapters, and with the results reported by Frank et al. (1993). The informational content of the three facial expressions employed in the present research (i.e. neutral expressions, posed smiles and genuine smiles) was sufficient for perceivers to be able to reliably determine the presence or absence of a positive emotional state. Although such sensitivity was generally accompanied by some degree of response bias, this was not completely unexpected. Given that two-thirds of the facial displays participants saw were smiles of some form, and, consistent with a positivity bias (Miller & Felicio, 1990) smiles of any description may tend to be commonly associated with happiness generically (Abel, 2002), it is not unexpected that a bias in the form of a greater willingness for participants to respond ‘happy’ would be shown.

Of note, however, is that under some circumstances, sensitivity to positive affect was observed in the absence of any appreciable bias. When judging the emotion felt, judgments of closed mouth smiles were shown to be accurate and unbiased. A lack of information irrelevant to the specification of happiness (such as the exposure of the teeth during a smile), and an instruction to judge the emotion felt led participants to be able to correctly identify posed smiles (and neutral expressions) as not reflecting happiness, but genuine smiles as reflecting this emotion. It is suggested that these findings can be considered consistent with the claim by Frank et al. that amplification of the ‘signal’ strength of a genuine smile facilitates identification of smile veracity, or in the case of the present research, the detection of happiness. Allowing participants to view the full duration of each expression using video appeared to provide additional information pertinent to the judgment task at hand so that less biased judgments were observed for this condition. Indeed, of the morphological differences between posed and genuine smiles (see Chapter 1 for details), only the Duchenne marker (i.e. contraction of *orbicularis oculi*) and indications of symmetry are available for perception from static photographs, while by comparison dynamic displays additionally include information regarding the duration and ballistic course of the expression (i.e. transition from onset to apex to offset). Therefore, it appears that the additional information specifying emotional state made available when facial expressions were presented dynamically was used by participants to facilitate detection of positive affect. This finding is clearly in line with predictions derived from an ecological approach to psychology whereby it is advocated that information is best revealed in events, in this case expressions, that unfold over time rather than represented as static, albeit prototypic, facial configurations.

In summary, the findings of the present research provide evidence that the social perceiver is able to accurately detect positive affect as specified by facial expression. Information specific to positive affect was discriminable from that not specific to this emotional state, but morphologically similar. That is, the characteristics of a genuine smile provided sufficient task-relevant information for perceivers to be able to reliably identify positive emotional state. Significantly, this study provides the first rigorous account of the sensitivity of the perceiver to the properties that structure information to specify the presence or absence of positive emotional experience by means of facial expression.

However, participants in this study were directly instructed to judge emotional state, an activity that is not particularly representative of a normal social interaction. By drawing attention specifically to emotional state, participants may have been led to attend to aspects of the target's behaviour and appearance in a different, perhaps more thorough, manner than they otherwise might when engaging in an actual interaction. Indeed, this task essentially implies a tacit knowledge of positive emotional states (and how these may be specified physiognomically) that is called on by participants when making the judgments required. Therefore, it is difficult to be confident in generalising from the sensitivity to indications of emotional state shown in the present study, to real-world interactions when individuals are unlikely to be judging expression veracity or emotional state as explicitly or carefully. The next study in the present research is intended therefore to assess perceivers sensitivity to the difference between posed and genuine smiles in a manner that does not draw attention specifically to the nature of the judgement required.

CHAPTER 5

Sensitivity to Emotional State Specified by Posed and Genuine Smiles

In the previous chapter evidence was presented to support the notion that the social perceiver is sensitive to the differences between posed and genuine smiles. Specifically, it was shown that perceivers can reliably detect the presence or absence of positive affect when viewing photographs or video-clips of individuals displaying posed smiles, genuine smiles, or not showing any facial expression of emotion. However, the conditions under which participants made their emotion judgements were somewhat conducive to accuracy and removed from the reference situation of an actual interaction. Participants were explicitly instructed to judge emotional state in a tightly controlled laboratory context under optimal viewing conditions and without any particular time pressures or distractions. While it is not suggested that the results of Experiments 1a and 1b were artefacts of any of these factors, the nature of the procedures employed prevents any firm conclusions being drawn regarding perceiver sensitivity to smile veracity during actual social interaction. In particular, the requirement to overtly judge emotional state, albeit the basis for these studies, is not representative of real-world interactions where such explicit judgements are unlikely due to the complex, often multimodal nature of social exchange. During interaction, the social perceiver is not ordinarily in the practice of making overt, distinct judgments of facial expression, emotional state or any other such qualities. Rather, consistent with an ecological approach to psychology, the social perceiver is assumed to be attuned to the affordances of their environment. In this sense, as discussed in Chapter 2, facial expressions themselves are not affordances, they merely structure the ambient array in a manner that specifies an affordance to an attuned observer.

Hence, drawing participants' attention directly to judgements of emotional state may lead to different perceptual outcomes than would occur without such direction, or more generally, during actual social interactions. Thus, although Experiments 1a and 1b provided clear evidence that the social perceiver *can* be sensitive to positive affect as specified by facial expression, it remains to be seen whether such sensitivity is manifest without explicit instruction to judge emotional state. This chapter will report a study that investigated whether perceivers were sensitive to the difference in emotional state as specified by posed and genuine smiles when they were not specifically instructed to make judgements of emotional state.

Previous Research Investigating Sensitivity to Smile Veracity

In a follow-up to the study reviewed in the previous chapter, Frank, Ekman and Friesen (1993, study 3) investigated the nature of impressions formed of individuals displaying posed or genuine smiles. Participants viewed videos of 20 individuals displaying either posed or genuine smiles[62] and subsequently made ratings of each individual on fifteen 7-point rating scales, each anchored by a bipolar personality-emotion adjective pair[63]. Frank et al. reasoned that this approach more closely resembled an interaction situation compared to when participants were required to make explicit judgments of smile type. Their results revealed that impressions of individuals expressing genuine smiles were generally more positive compared with impressions of those expressing posed smiles. Furthermore, in regard to the individual facial displays, the more accurately a given individual's posed and genuine smiles

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[62] Two versions of the video were employed so that each participant saw only one smile (either posed or genuine) from each individual. The facial displays were identical to those used in the second study reported by Frank et al. (1993) and described in detail in Chapter 4.

[63] Specifically, ratings were made along the dimensions: outgoing-inhibited, expressive-unexpressive, sociable-withdrawn, calm-agitated, natural-awkward, stable-unstable, relaxed-tense, honest-dishonest, sincere-insincere, trustworthy-untrustworthy, dominant-submissive, likable-unlikable, felt pleasant-felt unpleasant, act pleasant-act unpleasant and genuine-sarcastic.

were identified in the explicit judgment task (i.e. Frank et al. study 2), the more positive their genuine smile was rated compared to their posed smile in the impression formation study (i.e. Frank et al. study 3). The authors suggested that the same factors that contributed to the identifiability of posed and genuine smiles when making explicit judgments (i.e. salience of *orbicularis oculi*) were also associated with more positive impressions of an individual displaying a genuine smile compared to a posed smile. Therefore, they concluded, the signal value of the markers of a genuine smile extends beyond explicit judgements of smile veracity to also impact on impressions formed of individuals on the basis of their facial expressions.

While the approach adopted by Frank et al. (1993) of attempting to enhance the ecological validity of their findings by employing an experimental procedure intended to more closely resemble an actual interpersonal interaction is to be applauded, a number of factors remain which threaten such validity. As described, explicitly instructing participants to judge smile veracity does not approximate well to the general nature of social interaction and engagement. Under normal circumstances the social perceiver will not make such deliberate and constrained discriminations. Thus, a methodological concern with regard to the research reported by Frank et al. remains, namely the explicit instruction to judge various personality traits. In the same manner that the perceiver is unlikely to make considered judgements of smile veracity when interacting with others, explicit judgements of personality traits are also somewhat unrealistic (Baron & Boudreau, 1987; Baron & Misovich, 1993; McArthur & Baron, 1983). In short, the method employed by Frank et al. retains the demand of participants to make evaluations of others that are unlikely to occur during normal social interaction.

Although social perceivers are attuned to information specifying relevant dispositional qualities of conspecifics in terms of social affordances, overt judgements of personality traits do not adequately simulate the nature of this relationship between the perceiver and their environment. As discussed in Chapter 2, affordances and traits are not interchangeable terms (Baron & Misovich, 1993; McArthur & Baron, 1983). Traits are abstract properties that must be inferred from appearance, behaviour or even other traits (Fiske & Taylor, 1991), whereas social affordances can be perceived directly in that they present as real, tangible opportunities for interaction. Baron and Misovich (1993) express this distinction in terms of traits being "thingless properties that must be inferred" (p. 541), compared with affordances being "propertied things that can be perceived directly" (p. 541). Affordances, in this sense, are lawfully linked to disposition (e.g. affective state) in a manner that systematically structures the ambient array (e.g. smile type) such that information is available for perception. By comparison, traits rely on the constructive process of the perceiver to interpret such characteristics based on their existing knowledge and beliefs. In addition, in contrast to social affordances, traits fail to capture the individualised nature of the actor-environment system (McArthur & Baron, 1983). Presumably, the degree to which one is perceived, for example, as outgoing[64] is dependent on a multitude of factors, some of which pertain to the perceiver. In a trait sense therefore, an extreme introvert is not likely to perceive the outgoingness of a given individual in the same manner as an extreme extrovert. Social affordances, on the other hand, are inherent to the perceiver because, by definition, an affordance is specified by properties of the environment relative to the properties of the individual. That is, affordances are individualised. Characterising social perception as a global phenomenon, bereft of individual

[64] Or more correctly, whether one is perceived as affording the opportunities for interaction that an out-going person has.

differences, as implied when using traits to approximate the dispositional properties of interaction partners, does not adequately reflect the reciprocal, mutualistic nature of psychological activity advanced by proponents of the ecological approach. Therefore, in line with the present commitment to a realist account of social perception, evaluating personality traits by using predetermined adjective-pairs, appears to be fundamentally distinct from the general activity of spontaneously forming impressions, or more specifically, detecting the social affordances of a particular social interaction. Thus, with regard to the impression formation study reported by Frank et al. (1993, study 3), it is questionable whether the procedure employed (making explicit ratings of personality traits) adequately represents the nature of real-world interactions.

A handful of other studies investigating aspects of perceiver sensitivity to the differences between posed and genuine smiles have also been reported in the literature. Among these, Surakka and Hietanen (1998) examined, what they termed, facial and emotional responses to posed and genuine smiles. Participants were required to report their emotional and empathic experiences after viewing static photographs of neutral expressions, posed smiles, and genuine smiles. Muscular contractions of the face were also measured using facial EMG as a means to explore the nature of any mimicry by participants of the facial displays observed. Specifically, contractions of *orbicularis oculi* (FACS AU6) and *zygomatic major* (FACS AU12) were monitored while the participant viewed the smiles. Surakka and Hietanen reported that facial EMG recordings in both the eye and cheek regions were significantly stronger (i.e. greater intensity of muscle contraction) when viewing genuine smiles compared to neutral expressions, but no such difference was found when comparing posed smiles and neutral expressions. Furthermore, participants reported feeling more positive after viewing genuine smiles, which in turn, was positively correlated with ratings of empathy. Overall, it appears that participants in this study mimicked genuine smiles with genuine smiles,[65] but did not mimic posed smiles any differently to neutral expressions. Moreover, participants reported feeling more positive and empathic toward an individual expressing a genuine smile compared to those displaying either posed smiles or neutral expressions. However, these findings should be interpreted with caution as the facial displays employed by Surakka and Hietanen contained a methodological flaw. To generate the facial displays, "a male and a female actor were guided to produce three static facial expressions" (p.25), thereby essentially producing a simulated genuine smile, an approach, as described in Chapter 3, that falls somewhat short of the criteria required for adequate ecologically valid facial displays. Furthermore, visual inspection of these facial expressions suggests noticeable differences in the relative intensities of the posed and genuine smiles. For the female actor the intensity of *zygomatic major* contraction was slightly greater for the genuine smile compared to the posed smile, while this difference was more pronounced for the male actor.[66] As a result, it is unclear whether the differences in participant responses were due to smile veracity, smile intensity, or some artefact of employing simulated genuine smiles as facial displays.

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[65] Or, at least, the muscles involved with genuinely smiling were recruited when viewing genuine smiles.

[66] FACS ratings of intensity of AU 12 taken from a reproduction of Surakka & Hietenan's original facial displays (fidelity of these photographs was low, hence intensity ratings were approximations only) indicate that for the female actor, posed smile = AU 12C, genuine smile = AU 12D, while for the male actor, posed smile = AU 12B, genuine smile = AU 12D. FACS intensity ratings range from A (trace) to E (maximum).

In contrast to the laboratory studies reviewed to this point, Scherer and Ceschi (2000) provided support for the notion that perceivers are sensitive to the meaningful differences between posed and genuine smiles using evidence derived from a naturalistic setting. These authors conducted an observational study at a major international airport study whereby they surreptitiously identified and subsequently videotaped airline passengers whose luggage had failed to arrive. The authors reasoned that this situation is likely to induce a spontaneous emotional reaction in most people, and thus has high ecological validity for studying the expression and recognition of everyday emotional responses. One of the key factors investigated in this study was the impressions of the passengers formed by the airline staff who assisted them with the lost baggage claims. After dealing with each passenger, the staff member, who was blind to the purposes of the study, was asked to rate that passenger's emotional state. The video tapes of each passenger were also examined for the occurrence and frequency of posed and genuine smiles. The authors reported a positive relationship between the incidence of genuine smiles exhibited by passengers with lost luggage and ratings of their mood made by the airline agents. Importantly, the frequency of posed smiles exhibited was not related to the perceptions of passenger's mood. In effect, this finding partially replicates the results from Frank et al.'s impression formation study, as well as the findings from Experiments 1a and 1b in the present research, as the airline agents displayed sensitivity to the difference between posed and genuine smiles when making explicit ratings of emotional state. Passengers who exhibited more genuine smiles were perceived to be in better moods than those who expressed fewer genuine smiles, while the expression of posed smiles was not related to perceived emotional state.

In many important ways, these findings provide some of the most convincing evidence to date to indicate that social perceivers are in fact sensitive to the meaningful differences between posed and genuine smiles. The smiles were expressed spontaneously during the course of actual social interaction, without the knowledge that video recordings, or other observations, were being made. The airline staff were permitted to perceive actively (compared with the imposition of tightly controlled visual information common to many laboratory-based procedures), while engaging in their general day-to-day workplace activities unaware of the purposes of the study. A naturalistic setting for both the production and perception of facial displays of emotion such as this provides high levels of ecological validity and, hence, strong grounds to generalise the findings from the research context to social interactions more generally. However, as mentioned previously, the requirement for the airline staff to make explicit ratings of emotional state of the passengers may not resemble the more spontaneous detection of social affordances advocated here. In addition, the general nature of correlational studies precludes the drawing of firm conclusions due to the inability to control for the effects of extraneous variables.[67] While Scherer and Ceschi's study represents many of the factors required for a valid demonstration of the sensitivity of the social perceiver to the meaningful differences between posed and genuine smiles, the lack of experimental control combined with the requirement to explicitly judge emotional state, suggests that any definitive conclusions regarding this sensitivity remain elusive.

[67] Perhaps, for example, an alternative explanation for these findings could be the following. A halo effect moderated the interaction between the staff and the passengers such that more attractive passengers received better treatment from the airline staff which in turn helped relieve the stress and anxiety of losing their luggage, induce positive mood and thereby lead to a greater incidence of genuine smiles. In this hypothetical case, general attractiveness, rather than facial expression may have been driving any effects observed. Of course, attractiveness and genuine smiling may be strongly related, in which case the interaction between passengers and staff becomes more complex again. Overall, it may have been better for Scherer and Ceschi (2000) to also examine more behavioural measures such as the spontaneous expressions of the staff, or the time spent attending to each passenger as more informative indices of their impressions.

Finally, Williams, Senior, David, Loughland and Gordon (2001) reported research that, while not examining the nature of perceiver sensitivity to posed and genuine smiles directly, provided further evidence that such a phenomenon may exist. These authors investigated the visuo-cognitive strategies underlying the perception of facial expressions. By tracking eye-fixations of participants viewing photographs of neutral, sad, and happy[68] facial expressions these authors were able to determine whether perceivers attend differently to each expression. Williams et al. reported that, compared to neutral and sad facial expressions, perceivers made proportionately more and longer fixations to the outer corners of the eye when viewing happy faces. Given that this is the specific location on the face where indicators of genuine smiling occur (i.e. the Duchenne marker), it appears that when a generic smile is detected (most probably by the presence of *zygomatic major* contraction), attention is shifted specifically to the area around the eyes where the contraction of *orbicularis oculi* is most visible, potentially as a means of establishing the veracity of the expression. No parallel 'eye-checking' strategy was found for either neutral or sad facial expressions. The ocular dynamics examined in the Williams et al. study are unlikely to be the product of deliberate eye movements, rather, as the authors suggest, the fixation patterns reported provide preliminary evidence for an evolved perceptual strategy to specifically distinguish between posed and genuine smiles. Although aspects of this research (e.g. static facial displays, eye-tracking equipment etc.) do not approximate the context of real-world interactions well, the fact that participants were not provided with any explicit instructions, rating tasks or other goals, and yet showed patterns of ocular behaviour conducive to a perceptual sensitivity to the differences between

[68] It is unclear what type of smiles (e.g. posed or genuine) were employed by Williams et al. (2001), however, the nature of the results suggest that such a pattern of eye-fixations will pertain to any smile, regardless of veracity.

posed and genuine smiles, offers support for the claim that the perceiver will exhibit such sensitivity during social interaction.

To summarise, the research reviewed to this point provides further support for the claim that social perceivers can be sensitive to the meaningful differences between posed and genuine smiles. Impressions of individuals expressing genuine smiles appear to be more positive relative to those expressing posed smiles (Frank et al. 1993; Scherer & Ceschi, 2000), while perceivers also reported feeling more empathic towards an individual exhibiting a genuine smile compared to a posed smile (Surakka & Hietanen, 1998) and show patterns of ocular dynamics advantageous to such sensitivity to smile veracity (Williams et al. 2001). However, although these studies offer greater ecological validity than the research reported in the previous chapter, whereby participants were required to explicitly judge smile type, factors inherent to each study that do not approximate well to actual social interactions, remain. In particular, it is suggested that requiring participants to make explicit ratings of personality traits does not map well to the spontaneous detection of social affordances advocated within the ecological approach to psychology. In this sense, it is important that any laboratory demonstration of sensitivity to the differences between posed and genuine smiles be carried out under conditions that pertain to the task-relevant context in which such sensitivity would normally be manifest. Importantly, any input from the researcher that is not a corollary to the reference situation (e.g. a real-world social interaction) jeopardises the extent to which findings can be applied and generalised beyond the laboratory. The remainder of this chapter reports the second study in the present program of research, which was intended to examine sensitivity to the differences between posed and genuine smiles, when the participants are not provided with an explicit task, goal, or judgement criteria.

The Present Research

Evidence was presented in the previous chapter to suggest that the social perceiver can, when directed to make explicit judgments, reliably detect the presence or absence of positive emotional state as specified by facial expression. Although these findings represent the first systematic account of such sensitivity, the methods employed preclude generalisation to actual social interactions where this form of explicit decision making is not likely to occur. Furthermore, in the present chapter a number of studies were reviewed that examined factors relevant to the sensitivity of perceivers to differences between posed and genuine smiles without drawing participants' attention toward concepts of smile type or veracity. However, as discussed, these studies also tended to suffer from procedures that do not approximate well to the reference situation of an actual social interaction. Most notably, employing concepts of personality traits as a means of knowing disposition, and again requiring participants to make considered, overt judgments does not approximate well to social interaction in a natural setting. As a result, although the research discussed to this point indicates, without exception, that perceivers are sensitive to smile veracity, no single study has been undertaken without experimenter-imposed constraints that do not pertain to normal interaction. Consequently, there is insufficient evidence to assume that when engaging in actual social interactions perceivers can reliably detect the presence or absence of a positive emotional state by means of distinguishing posed from genuine smiles. To reiterate, it is important that the researcher understands the properties of the environment available for perception in concert with the sensitivity of the perceiver to such properties before the relationship between the individual and their environment can be studied in a more ecological manner. While there are clear morphological distinctions available to the perceiver to specify smile veracity, the existing evidence regarding perceiver sensitivity to these distinctions, lacks applicability. The present study is intended to examine the sensitivity of perceivers to the distinction between posed and genuine smiles when not constrained by experimental requirements to view the facial expressions with any particular purpose or goal. To this end, a priming methodology was employed for the present study. The next section of this chapter outlines the theoretical background for these methods and provides a critique of the priming literature from a functional ecological perspective.

Priming, Automaticity, and Affect

A topic that has received considerable attention within the contemporary social perception literature is the study of automaticity and priming effects. Principally, this area of research is concerned "with the ways that internal mental states mediate, in a passive and hidden manner, the effects of the social environment on psychological processes and responses" (Bargh & Chartrand, 2000, p.254). The emphasis here is on the supposedly passive nature of the perceiver, whereby features of the environment are involuntarily processed by the cognitive system "without any mediation by conscious choice or reflection" (Bargh, 1997, p.2). Typically, researchers in this field study the elicitation of responses (e.g. attitudes, affect, goals, and behaviours) to stimuli presented either outside of conscious awareness (e.g. subliminal / suboptimal priming) or surreptitiously (e.g. tasks completed, ostensibly, as part of another experiment). Claims are then made regarding the seemingly 'automatic', 'nonconscious' impact the priming stimuli had on the outcome variable(s) of interest, of which, importantly, the participant had no knowledge.

The literature contains an abundance of examples of primed automatic behaviour, a number of which have investigated the perception of emotion, and specifically, the influence of affective primes on behaviour. For example, Murphy and Zajonc (1993) asked participants to make valence ratings of various novel Chinese ideographs, each of which was preceded by a photograph, presented extremely briefly (4 ms), of an individual either smiling[69] or frowning. Ideographs that had been preceded by a smile were rated more positively than those that had been preceded by a frown. Participants did not report noticing the presence of the facial expression and, in fact, were unable to accurately distinguish the faces used as primes from other faces not used in the experimental procedure, indicating that their evaluations were not deliberate or conscious responses to the presented primes. Dimberg, Thunberg and Elmehed (2000) also exposed participants very briefly (30 ms) to photographs of facial expressions while recording the activity of muscles in the face using EMG. Consistent with the results reported by Surakka and Hietanen (1998) discussed above, Dimberg et al. found that participants spontaneously contracted facial muscles specific to the expression they had been exposed to,[70] even though they were unable to explicitly report the nature of the expression. Finally, in a recent study Ravaja, Kallinen, Saari and Keltikangas-Jarvinen (2004) embedded photographs of happy, angry, or neutral facial expressions into video clips of news items. Each news clip (mean duration 51 s) contained a photograph inserted at 6 different points (at 2 s, 11 s, 19 s, 31 s, 40 s and

[69] Although it is unclear from the details provided, it appears as though Murphy and Zajonc (1993) employed photographs of posed smiles in this study.
[70] Specifically, greater activity of the *zygomatic major* was observed when exposed to a happy face, while greater activity of the *corrugator supercilii* (a muscle involved with frowning), was observed when exposed to an angry face.

50 s). The photograph was substituted for one frame of the news clip at each point such that when the clip was played at normal speed (50 frames per second), the photograph remained on the screen for approximately 20 ms. Participants viewing the news clips did not notice the embedded photographs, but did show evidence that these photographs had influenced their perceptions of the clips. News clips that contained happy face photographs were accompanied by a higher level of activity of both the *zygomatic major* and *orbicularis oculi* muscles of the perceivers, and were rated as more positive, trustworthy, and interesting than those containing neutral faces.

In a sense, priming studies provide an index for determining the sensitivity of the perceiver to specific environmental properties. The empirical effects derived from the experimental methodologies collectively considered to be studies of priming and automaticity such as those described above, tend to show a coherency between the objects of perception and the performance of the perceiver. Individuals tailor their actions to meet the requirements and opportunities of their environment, even when, as demonstrated by priming and automaticity research, no deliberate strategies to do so can be observed. For instance, given the adaptive benefit, it is hardly surprising that detection of an emotional expression is accompanied by action related to the meaning of that expression, regardless of whether the perceiver can subsequently describe, or even recognise the expression. On the other hand, it would be surprising if such effects were found when presented with a less meaningful display, perhaps, for example, an arbitrary shape or pattern. It is suggested that within the context of priming methodologies, sensitivity to particular environmental properties may potentially be indexed by systematically varying the nature of the referent for perception, while measuring performance relevant to the referent using a common metric. An immediate advantage of employing a methodology of this type is that sensitivity can potentially be measured without drawing the participants' attention to certain features of the world to be examined, thereby preserving an important feature of actual social interaction.

Thus, employing a priming methodology may be a suitable approach to meet the requirements of the present study, that is, to examine the sensitivity of perceivers to the distinction between posed and genuine smiles without an explicit requirement to judge emotional state. Given that robust effects relevant to the perception of smiles have been reported within the priming literature (e.g. Dimberg et al., 2000; Murphy & Zajonc, 1993; Ravaja et al., 2004), it is suggested that if perceivers are in fact sensitive to the meaningful differences between posed and genuine smiles, when primed with these expressions, such sensitivity may be manifest in terms of distinct outcomes relevant to the meaning of each expression. However, it is clear from the outset that priming and automaticity research, particularly in terms of the inherent explanatory focus on the automated, mediational role of cognition, may not be conducive to an ecological account of psychology. Hence, further consideration of priming and automaticity effects in terms of the ecological approach is warranted prior to employing such procedures.

Priming, Automaticity, and Ecological Psychology

Typically, the explanations offered for priming effects call into play cognitive-mediational notions regarding, for instance, the automatic activation of mental representations (Dijksterhuis & van Knippenberg, 1998), attitudes (Fazio, Sanbonmatsu, Powell, & Kardes, 1986), affective reactions (Murphy & Zajonc, 1993), stereotypes (Payne, Lambert, & Jacoby, 2002), trait constructs (Bargh, Chen, & Burrows, 1996) and thoughts (Anderson, Benjamin, & Bartholow, 1998) to explain the hidden mental operations that take place to produce the apparently unintended outcomes observed. Within this literature, it is typically suggested that primed mental processes are activated without any conscious intervention from the individual. That is, they result from the mere presence of relevant environmental stimuli (i.e. priming stimuli). In turn these mental processes are manifest in terms of similarly relevant responses (i.e. the primed behaviour or response), again without any intentional action on the part of the individual. Obviously, such mechanistic theorising is antithetical to the ecological approach to psychology (see Chapter 2). Not only do these explanations rest on the constructivist mentalism inherent to the dominant, information processing approach to social perception, but they also characterise the perceptual system as a linear stimulus-response mechanism, (potentially) 'programmed' to respond to various environmental cues or stimuli.[71]

Furthermore, a unifying feature of the experimental effects collectively considered to be demonstrations of *automaticity* (see Bargh, 1997) is the claim that, in these settings, perception occurs without awareness.[72] To proponents of an ecological approach to psychology, this claim is a clear misnomer. From the ecological perspective, to perceive, that is to detect or acquire information, is to be aware. According to Gibson (1979, p. 250) "the term awareness is used to imply a direct

[71] In fact, as discussed in Chapter 2, these are some of the very theoretical inadequacies that initially motivated Gibson to propose an alternative approach to psychology (see Gibson (1966; 1979), and indeed led to the related theories pertaining to the direct perception of affordances specified by the information available.
[72] Many terms are used in the existing, cognitivist literature to describe 'perception without awareness'. Bornstein and Pittman (1992), for example, suggest the terms: subliminal perception, unconscious perception, nonconscious perception, subception and implicit perception, as an incomplete list of alternatives.

pickup of information, not necessarily to imply consciousness".[73] Reed (1996) elaborates this important distinction, suggesting that awareness "is not necessarily to be conscious or self-conscious – it is just to show perceptually based capacities for meaningful discrimination and actions organized by those discriminations" (p. 24). Reed went on to explain that awareness requires no particular explicit knowledge on the part of the perceiver, only sufficient sensitivity to detect information specifying the relevant affordances of their environment. In this sense, awareness functions to *regulate* the relationship between the individual and their environment such that the affordances of the environment can be achieved or avoided as warranted. Clearly then, the distinction between the respective ecological and information processing approaches to the phenomenon of awareness and the implications for the study of perception, and psychology in general, extend well beyond differences in semantics or terminology. Requiring the referent of awareness (that is, what the perceiver is aware of), to be present in, as Gibson described, the 'theatre of consciousness', requires not only firm commitment to a Cartesian dualism (presumably the body can be *aware* of what the mind is not, if explanations of priming are to be accepted), but also acceptance of a number of other dualistic divisions including that between the conscious and the non-conscious, the automatic and the intentional, and most importantly between the individual and their environment. Such theoretical duality is contrary to the monistic commitments of Gibsonian ecological psychology as presented in Chapter 2 and which is adopted as the theoretical framework for the present research.

[73] In other words, for Gibson, 'aware of' meant 'sensitive to' rather than 'conscious of' information.

What then, should be made of the abundance of experimental effects claimed to be demonstrative of the automaticity of human cognition? It is clear than any researcher approaching the study of psychology from an ecological perspective would be well served by disregarding the overtly constructive, inference-based accounts of the mechanisms allegedly responsible for the empirical observations described as priming or automaticity effects. Ought the effects in isolation, that is the empirical observations themselves, be disregarded too? Perhaps not, after all many of the studies ostensibly concerned with priming and automaticity produce well controlled laboratory demonstrations of robust, replicable effects, which illustrate a coherent relationship between the individual and their environment. It makes good adaptive sense that accompanying the detection of, for instance, an affective facial expression is behaviour conducive to interaction with an individual experiencing the affective state specified by that expression. To illustrate: smiling and feeling positive toward a happy person, and conversely, frowning and feeling negative toward an angry person, may be a reasonably successful, albeit grossly over-simplistic, hypothetical heuristic for social interaction. The fact that such effects can be reliably produced in laboratory experiments reveals not what may occur 'in the brain', but that perception has, as Reed (1996) explained, a regulatory function which tailors or coordinates the perceiver's actions to their environment in an adaptive manner (Michaels & Carello, 1981).

Indeed, Gibson (1967, cited in E. J. Gibson, 2002, p.14) further considered awareness to be "an activity…a form of adjustment that enhances the pickup of information" (p. 129). Presumably here, Gibson was referring to an adjustment in the relationship between the individual and their environment to, or toward, some form of referent, possibly detected information. Given that information, in an ecological sense, can be anticipatory or predictive in nature (Lee, 1980), that is, it can specify what *will* occur, it seems reasonable that the detection of such information is manifest in terms of an adjustment, or attunement, toward *what that information specifies*. In fact one of the five hallmarks of human behaviour proposed by E. J. Gibson[74] (1994) was that of *prospectivity*, the "forward-looking character of behaviour" (p. 72), whereby the activity of the individual is preparatory for realising forthcoming affordances. "Information about the environment, the actor's bodily effectiveness, and the fit between the two is constantly coming in; as changes in the information are observed, better and earlier detection of affordances is possible" (E. J. Gibson, p. 72). Thus, the prospective individual[75] is able to use the information that specifies the affordances of their environment to direct activity and attention toward the emerging features of a situation in a functionally specific manner (Reed, 1996).

Perhaps then, it is the characteristics of the prospective nature of the relationship between the individual and his or her environment that are observed when priming and automaticity are studied experimentally. As suggested, many such effects show potential for adaptive function of the kind expected of a prospective organism. Furthermore, if awareness of meaningful features of the relationship between the individual and their environment is not channelled usefully toward the constantly emerging features of that relationship, such awareness has little purpose. In a similar sense Michaels and Carello (1981) asserted that "for perception to be valuable, it must

[74] The other four hallmarks of human behaviour proposed by E. J. Gibson (1994) were: agency (the self in control); flexibility (the transfer of means); communicative creativity (multiplication of means of communication) and, retrospectivity (the backward-looking character of behaviour).
[75] Prospectivity, in fact, is characteristic of animate creatures. For instance, the locomotion of a human to catch a ball is a demonstration of the same type as that of a paramecium locomoting toward a source of food (Reed, 1996).

be manifest in appropriate and effective actions on the environment" (p. 47). There is no reason why the very function of perception should not be observed in laboratory experiments purporting to be investigating priming and automaticity[76]. This is not a claim of validity, ecological or otherwise, for priming methodologies since the majority of these procedures bear little relevance outside of the laboratory context, but rather a reassertion of the position that for psychology, the only appropriate unit of analysis is the relationship between the individual and their environment. Participants in psychology experiments are still individuals in environments, albeit often environments consisting of experimenter-constructed constraints. Hence the 'same rules' still apply, that is, psychology still occurs and the individual continues to detect information specifying the affordances of the environment and to act accordingly. Animate organisms simply have to act on this information to survive. However, one critical issue here is the degree of correspondence between the constraints of the experimental context and those of the reference context, which ought to be some real-world situation or phenomenon. As discussed in previous chapters, the extent to which the constraints imposed in a laboratory experiment are not present in the reference situation determines the meaningfulness with which the findings may be applied and generalised. If the constraints of the laboratory do not match those of the reference situation, the ecological validity of the procedure suffers, whereby any knowledge gained may only apply to the context of the experiment, and not beyond.

Typically, the laboratory procedures employed when studying phenomena described as priming and automaticity (Bargh & Chartrand, 2000) suffer from very low levels of ecological validity, and therefore, may have little applicability to behaviour outside of

[76] In fact it would be peculiar indeed if such functions were somehow temporarily suspended when participating in psychology experiments.

the laboratory context. For example, many of the priming techniques employed (e.g. scrambled sentence task, Srull & Wyer, 1979) are not representative of the means by which individuals ordinarily acquire information about their environment, yet are shown to consistently produce experimental effects. In keeping with the current approach, these effects may not be applicable outside the experimental context, yet are consistent with what might be expected of a prospective agent given the constraints and circumstances imposed. Other methods of priming, such as the brief presentation of visual information, particularly facial expressions of emotion, may, arguably, be more appropriate to generalisation beyond the laboratory. There are occasions when only a glimpse of another person's face is available or very rapid perception and action is desirable. For instance, there may literally only be a fraction of a second between detecting a facial expression specifying anger and being assaulted. Numerous studies have shown such efficiency to be within the capacity of the human perceiver in that relevant actions, such as frowning at an angry face or smiling at a happy one, accompany detection of an affective facial display, even when the presentation time is very brief (e.g. Dimberg & Ohman, 1996; Livingston & Brewer, 2002; Murphy & Zajonc, 1993; Ravaja et al., 2004; Stapel, Koomen, & Ruys, 2002). However, on the whole, these studies also remain limited in generalisability beyond the sort of reference situation where the availability of information is so tightly and temporally bound. Normally, of course, perceivers are able to actively explore the events of their environment rather than be passively exposed to the constrained information supplied by the experimenter.

However, effects conceptually very similar to those found in priming and automaticity studies are occasionally reported from studies conducted outside of the laboratory. In a naturalistic setting Gueguen and De Gail (2003) demonstrated the impact of detection of a smile on subsequent behaviour. In this study, a confederate made eye contact with pedestrians in a busy inner city supermarket. Once eye contact was established, the confederate then smiled[77] at half of the pedestrians, and maintained a neutral expression toward the other half. A second confederate, who was instructed not to make eye contact, then dropped a package of computer disks while an observer recorded whether or not the pedestrian offered assistance to pick up the disks. It was reported that pedestrians who had been smiled at were significantly more likely to help than those who had not. In many ways, the Gueguen and De Gail study parallels a basic priming procedure. Participants were exposed to a meaningful event (i.e. eye contact and subsequent expression), in this case in a very naturalistic setting, and performance on a subsequent, conceptually relevant task was measured. Importantly, no instructions, warning or other information was provided to participants, only the initial facial expression and subsequent opportunity to lend assistance were experimental contrivances; in all other respects, therefore, the participants were engaging in their regular daily activity. While this study may suffer from the traditional trade-off between experimental control[78] and mundane realism generally present in any comparison between laboratory and field settings, it provides an important empirical link between experimental studies of priming, and illustrates how these effects may be applied to a real world scenario. Without confirmation that priming can exist outside of the laboratory, the general lack of ecological validity and potential for generalisability inherent to many laboratory-based priming procedures, means that even the most well developed theoretical account of such effects needs to be treated with scepticism. Demonstrations such as that reported by Gueguen and De

[77] Presumably a posed smile on most occasions.
[78] Smile veracity, for instance, could not be controlled in this research.

Gail, establish a reasonable foundation for suggesting that the social perceiver may in fact, on the basis of being a prospective agent, exhibit characteristics similar in concept to the empirical observations frequently reported in priming studies.

Turning attention back to the present research, it is suggested that the methods employed to study priming effects may, in an adapted form, be useful for assessing the sensitivity of perceivers to the meaningful differences between posed and genuine smiles. The adaptive benefits of such sensitivity are clearly prospective in nature. Knowing the veracity of an interaction partner's smile (i.e. whether they are experiencing positive affect or simulating that experience) is helpful for guiding subsequent interaction. Given there is evidence that seeing a static photograph of an individual smiling, even only very briefly, can have consequences for subsequent behaviour (e.g. Murphy & Zajonc, 1993; Ravaja et al., 2004), it seems reasonable to question whether such an effect may be moderated by the veracity of the smile itself. Thus, in line with the purposes of this stage of the present research; to assess perceiver sensitivity to the differences between posed and genuine smiles, the second study in this thesis will utilise a priming methodology.

Experiment 2

It is important to note at the outset that the present study is not intended to be representative of real-world social interaction, and hence lacks the degree of ecological validity championed earlier in this and previous chapters. This study is intended, however, to further test the hypothesis that perceivers are sensitive to the differences between posed and genuine smiles. Experimental evidence was presented in the previous chapter to suggest that when required to make explicit decisions regarding the presence of positive emotional state, perceivers were able to use the information specified in both photographs and video of facial expressions to accurately detect emotional state. The present study is intended to provide an additional assessment of such sensitivity without providing participants with any explicit goals or instructions to evaluate smile veracity by employing a priming methodology.

Experiment 2 in the present research involved briefly displaying static photographs of various facial expressions to participants who were ostensibly engaged in a separate task in which they were required to judge the valence (i.e. positive or negative) of a series of English words. It has been previously demonstrated that less time is required to categorise the valence of a word when it has been preceded by a prime of the same valence as the target (Fazio et al., 1986). Thus, it is predicted that participants will exhibit different response latencies when identifying the valence of positive words, depending on whether the word had been preceded by a conceptually related display of positive emotion (i.e. a genuine smile) or an irrelevant, simulated display of happiness (i.e. a posed smile). In other words, detection of the positive emotional state specified by genuine smiles is predicted to influence the categorisation of words, while posed smiles, as expressions not specific to any emotional state, are not predicted to have this effect. Specifically, it is hypothesised that the time taken to identify positive words will be facilitated by prior exposure to a static photograph of a genuine smile, but not a static photograph of a posed smile.[79]

[79] No predictions are made in regard to the effect of exposure to the facial displays on time taken to identify negative words. The claim in the present study is one regarding the prospective nature of perception which is predicted to be evidenced in the facilitation of categorising positive words, rather than any inhibitory effect regarding identification of negative words. In this sense, for this study, negative words were essentially 'fillers', to allow judgments of word valence to be possible.

Method

Participants.

Participants in Experiment 2 were 14 students (7 female) recruited from the University of Canterbury. They ranged in age from 18 years to 31 years (*M* = 22.6 years, *SD* = 5.2). Each participant was given a $2 scratch-and-win lottery ticket upon completion of the procedure.

Facial displays.

Three facial displays (a neutral expression, a posed smile, and a genuine smile) were selected from each of two of the thirteen individuals who participated in the facial display generation procedure described in the Chapter 3 to meet the criteria described below.

The within-participants design of the present study requires that all participants are exposed to all combinations of facial displays and target words, making for a relatively large number of trials. Hence, the facial displays from only two individuals were included in the present study in order to avoid extremely long testing sessions and the possibility of fatigue and boredom on the part of the participants influencing the results. Facial displays of smiles of moderate intensity were selected to ensure any effects were not the result of the extremes of a very low or high intensity expression. Very low intensity smiles are likely to be difficult to detect regardless of veracity and therefore mask potential effects due to low signal strength. Very high intensity smiles may pose a similar problem as described by Frank et al. (1993) who reported that perceivers were not as accurate distinguishing posed from genuine smiles when the expressions were of a high intensity. As described in Chapter 3, these authors argued that intense contraction of *zygomatic major* produces a bagging of skin below the eyes that may be mistaken for *orbicularis oculi* contraction. In a similar sense, the results of Experiments 1a and 1b reported in Chapter 4 suggested that smiles with the teeth exposed were more likely to be classified as expressions of happiness regardless of veracity, when compared with closed mouth smiles. Therefore, all smile displays included in the present study were of closed mouth smiles. Expressions from both a male and a female were included to allow for differential effects of facial display sex to be observed. While any generalisations regarding the effect of target sex on perceptions of posed and genuine smiles are not able to be drawn, as only one example of displays from each sex has been included, the inclusion of both male and female facial expressions may provide an initial indication as to any potential role of sex differences in terms of the current investigation.

In addition to the neutral expression, posed smile, and genuine smile selected from each individual's facial displays, two additional displays were constructed. For each face, a composite smile was constructed whereby the eye area from the individual's posed smile was digitally cropped and superimposed onto the genuine smile display. This manipulation was intended to create, artificially, a smile that contained indications of a genuine smile, but in the absence of contraction of *orbicularis oculi*. As discussed in Chapter 1, in addition to the Duchenne marker (contraction of *orbicularis oculi*) genuine smiles are comparatively more bilaterally symmetrical than posed smiles. By superimposing the eye region from a posed smile (which does not feature contraction of *orbicularis oculi*), onto a genuine smile (which does feature the marker of symmetry), a preliminary assessment of the relative contribution of each respective marker (i.e. Duchenne and symmetry) to the identification of smile veracity can be made.[80] A fifth facial display was constructed by digitally inverting the mouth and eyes of the neutral expression of each individual. In effect, this facial display acted as a baseline by which the effects of the facial expressions could be compared. This 'scrambled' face contained the same features as the natural faces, but was arranged in an unstructured, socially meaningless manner, such that these 'faces' should not influence word identification in the same prospective manner as the natural facial displays. Although the neutral facial displays could serve this purpose, factors associated with the specific configurations of individual faces (e.g. facial attractiveness) may play a role in the word evaluation task. Furthermore, due to the artificial nature of both the composite and scrambled facial displays, analyses were performed separately. The initial analyses including all five facial display conditions, while the subsequent analysis included only the natural faces.[81]

Target words.

Thirty target words (15 positive, 15 negative) were selected from the Affective Norms for English Words (ANEW) database (Bradley & Lang, 1999a). ANEW is a set of 1034 commonly used English words that have established norms for ratings of valence, arousal, and dominance as well estimates for frequency of use. Words were selected on the basis of valence ratings and balanced for frequency of use. Positive words were selected from those rated >7.5 on a 9-point scale, while negative words were selected from those rated <2.5 on the same scale. Selection of words with very

[80] Specifically, for both the male and female facial displays, AU12 (*zygomatic major*) contraction was bilaterally asymmetrical for the posed smile (left side: FACS intensity C, right side FACS intensity B for both male and female), but bilaterally symmetrical for the genuine smile (left side: FACS intensity C, right side FACS intensity C for both male and female). Hence the constructed composite smiles were indeed bilaterally symmetrical.

[81] The constructed composite and scrambled facial displays are not valid referents of social interaction, and while their inclusion may be informative in the context of the current investigation, given the emphasis placed on maintaining a high level of ecological validity in the present research, it is important to include analyses that consider only the effects of the natural facial displays on word identification.

clear meanings was intended to ensure that any deliberation due to uncertainty when interpreting the words was minimised, thereby providing for more accurate reaction time measurements. Word frequency estimates were provided with ANEW, although it is unclear the unit of measurement employed. Using the measures supplied there was no difference between the frequency of use of the positive and negative words lists, $t(28) = 0.16, p = 0.87$, ($M_{\text{positive}} = 66.8$, $M_{\text{negative}} = 61.8$). The complete word lists with valence ratings are provided in Appendix I.

Design.

A 5 (Facial expression: Scrambled / Neutral / Composite smile / Posed smile / Genuine smile) x 2 (Participant sex: Male / Female) x 2 (Facial expression sex: Male / Female) x 2 (Word valence: Positive / Negative) mixed model design with repeated measures on the first and last 2 factors was employed. Orders of facial expression and word presentation were randomised so that all participants saw all combinations of expressions and words.

Apparatus.

Facial displays and words were presented on a 17" colour computer monitor using software specifically programmed for the task (Walton, 2003a) and a PIII 650mhz personal computer running Windows XP Professional.

Procedure.

Participants were invited to take part in an experiment that was described as investigating mood and word recognition. Upon arrival to the laboratory each participant was given an information sheet (see Appendix J) that provided a brief description of the research. In this description, it was explained that the experiment was concerned with the impact of mood on performance in a word categorisation task. After agreeing to take part each participant signed a consent form (see Appendix K) and was ushered into a separate testing room and seated approximately 60cm from a computer monitor. Instructions for the task were presented on the computer screen. Specifically, participants were informed that they would be seeing a series of words presented individually on the computer screen and their task was to decide, as quickly and accurately as possible, whether each word was positive or negative in meaning, which they should indicate with a key press. They were told that they may see a face appear on the screen, but to ignore the face and concentrate on the word judgment task. The experimenter then checked that the participant understood the instructions. In order to help maintain the cover story of the experiment, participants were also required to complete an analogue mood scale (see Appendix B) once prior to the computer task.

The task began with a practice session consisting of 8 word judgment trials. Eight words and one facial photograph not used in the experiment itself were used for the practice session. On each trial a fixation cross first appeared in the middle of the screen. After a period, which was varied randomly from 1 second to 3 seconds to avoid anticipatory responses, the cross was replaced by a facial display that remained on the screen for 50 msecs. This period is sufficient for accurate detection of emotional state (Dimberg et al., 2000; Stapel et al., 2002), but does not allow time for any detailed examination.[82] The facial display was immediately replaced by a target

[82] Williams et al. (2001) for instance suggest that 100-200 msecs is the minimum period required for a eye fixation.

word that remained on the screen until the participant responded. All 300[83] facial display and word combinations were presented and order of word and facial display presentation was randomised. A 30-second pause in the procedure was introduced after every 50^{th} trial to minimise the effects of fatigue and boredom. After completion of the procedure participants were debriefed and thanked for their time. The entire procedure lasted approximately 20 minutes.

Data analysis.

The dependent measure in this study was response latency. Such data typically show a positively skewed distribution in that there is constraint at the lower end of the scale (i.e. fast reaction times), but not at the other extreme, where there is no real limit to how slowly a participant can respond. For this reason, transformations are often applied to meet the assumptions of normality required for analysis of variance (Bargh & Chartrand, 2000). Often, however, even after transformation, outliers remain, generally at the upper end of the distribution (i.e. very long latencies), usually due to lapses in attention and concentration by the participant. It is routine to trim such outliers from the data set if they clearly do not conform to the distribution expected for the experimental procedure employed (Ratcliff, 1993). For instance, especially long response latencies (e.g. > 2 secs) in experiments where participants are required to respond as quickly as possible to simple tasks such as word judgments, are more than likely to be the result of factors other than those under investigation. Given that meaningful differences in reaction time studies may be very small (Bargh & Chartrand, 2000), these differences are likely to be obscured by outliers not related to the phenomena being studied. Hence, it is common to remove outlying values in

[83] Thirty target words x 5 facial displays x 2 individuals = 300 presentations.

studies of this nature. Although there is controversy regarding how to unambiguously identify outliers from relevant data (Ratcliff, 1993; Ulrich & Miller, 1994), Uleman, Hon, Roman and Moskowitz (1996) suggest a conservative approach of removing values on a case-wise basis that lie beyond 3 standard deviations from the mean of that case.

These approaches to the 'cleaning' of reaction time data were applied to the present analysis. Initially any incorrect responses (i.e. identifying a positive word as negative or vice-versa) were eliminated and the distributions of the remaining data were examined for each participant. As expected, a visual inspection suggested that these distributions were not normal, and therefore did not meet the assumptions of ANOVA. Hence a $\log_{10}$ transformation was applied to each participant's data. After transformation, data outside the range: $M \pm 3.0$ SD were removed for each participant. In total 245 (5.8%) incorrect responses, and 62 (1.5%) responses identified as outliers were removed from the data set prior to analysis. Full details of errors and outliers removed for each participant are provided in Appendix L.

Results

Median reaction times were calculated for each participant by condition and compared using a 5 (Facial expression: Scrambled / Neutral / Composite smile / Posed smile / Genuine smile) x 2 (Participant sex: Male / Female) x 2 (Facial expression sex: Male / Female) x 2 (Word valence: Positive / Negative) mixed model ANOVA with repeated measures on the first and last two factors. Analysis was performed on $\log_{10}$ transformed data, but is reported as raw reaction times (i.e. antilogs) to aid interpretation.

No main effects were revealed. Importantly, as predicted a significant interaction was revealed between word valence and facial expression, $F(4,48) = 11.52, p < 0.01$, and is displayed in Figure 3. A comparison between the mean reaction times for each facial expression revealed that the time to identify positive words differed as a function of the facial expression preceding the word. Specifically, positive words were categorised more slowly when preceded by a control shape ($M_{\text{control}} = 650$ msecs) than by a composite smile ($M_{\text{composite}} = 610$ msecs), posed smile ($M_{\text{posed}} = 619$ msecs), or genuine smile ($M_{\text{genuine}} = 606$ msecs). Furthermore, positive words preceded by a genuine smile ($M_{\text{genuine}} = 606$ msecs) were categorised more rapidly than when preceded by a neutral expression ($M_{\text{neutral}} = 635$ msecs).

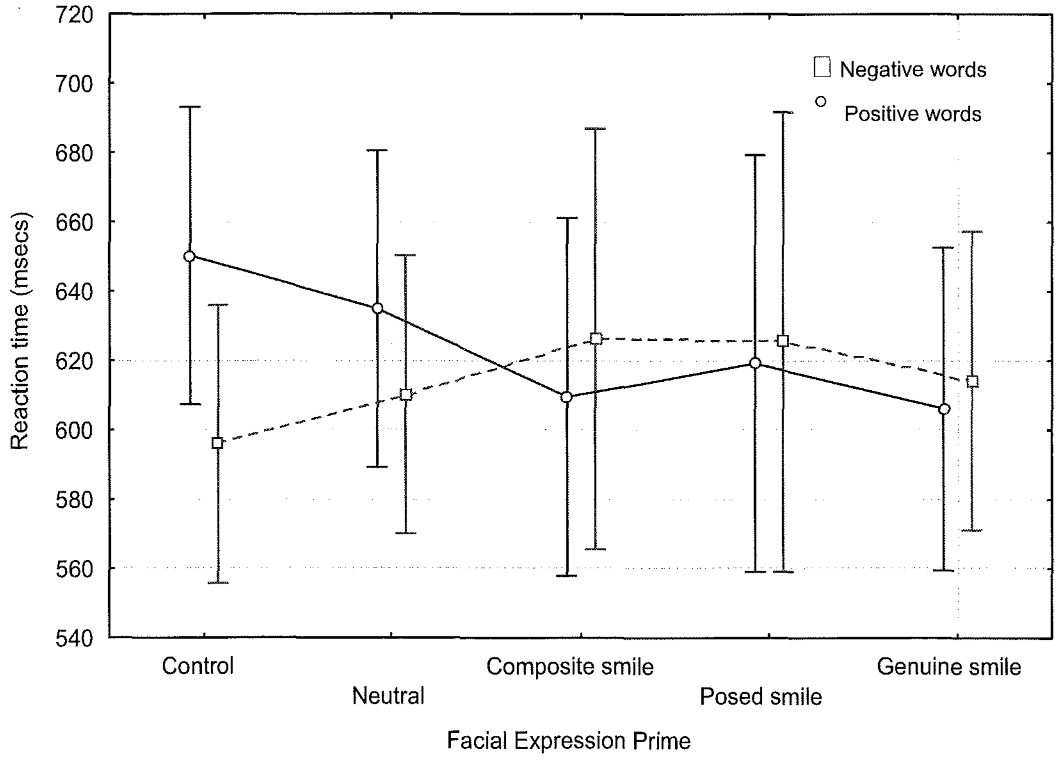

Figure 3: Line graph of time (msecs) take to categorise target words as a function of facial expression prime and word valence for Experiment 2.

No significant differences were revealed between the time taken to categorise positive words that were preceded by neutral expressions and those preceded by either composite smiles or posed smiles (Tukey a, $p < 0.05$).

An interaction effect was also revealed between word valence and participant sex, $F(1,12) = 7.11, p < 0.05$. A comparison between the means for each condition indicated that female participants were faster to identify negative words than positive words ($M_{negative} = 591$ msecs, $M_{positive} = 615$ msecs, Tukey *a*, $p < 0.05$), while no difference was found for male participants ($M_{negative} = 633$ msecs, $M_{positive} = 637$ msecs, Tukey *a*, *n.s.*). A further interaction was revealed between participant sex and facial expression sex, $F(1,12) = 6.37, p < 0.05$, due to female participants being marginally faster to identify words preceded by a female facial expression than a male facial expression ($M_{female} = 598$ msecs, $M_{male} = 609$ msecs, Tukey *a*, $p < 0.08$), while no difference was found for male participants ($M_{female} = 641$ msecs, $M_{male} = 631$ msecs, Tukey *a*, *n.s.*).

Planned comparisons were also performed to directly assess the hypothesised effects without inclusion of the artificial facial displays (i.e. control shape and composite smile). As such, the mean reaction time to identify positive words was compared between the neutral expression, posed smile, and genuine smile conditions. No significant difference was found between the time taken to identify positive words preceded by a neutral expression ($M_{\text{neutral}} = 635$ msecs) and those preceded by a posed smile ($M_{\text{posed}} = 619$ msecs). However, a significant difference was revealed between the time taken to identify positive words preceded by a neutral expression ($M_{\text{neutral}} = 635$ msecs) and those preceded by a genuine smile ($M_{\text{posed}} = 606$ msecs). Specifically participants were faster to identify positive words after exposure to a genuine smile, thereby confirming the effect reported above on the basis of post-hoc testing. No difference was revealed when time to identify positive words was compared between the posed and genuine smile conditions.

Discussion

As predicted, the time taken to identify positive words was facilitated by exposure to a static photograph of a genuine smile. Specifically, participants were faster to correctly categorise positive words preceded by a genuine smile, compared to the time taken to categorise positive words that were preceded by a neutral expression. Importantly, exposure to posed smiles had no such effect. The time taken to categorise positive words preceded by a posed smile was not significantly different from that for words preceded by a neutral expression. Thus, the data suggest that participants were indeed sensitive to the meaningful difference between posed and genuine smiles. Behaviour, in this case categorising the valence of a word, subsequent to the detection of a genuine smile was impacted in a manner consistent with the social significance of the expression. That is, genuine smiles, as facial expressions specifying positive emotional state, facilitated a conceptually related task (i.e. reading positive words). However, the simulated counterpart, posed smiles, which do not specify positive emotional state, did not impact on word categorisation any differently from an emotion-free, neutral expression. Thus, it appears that participants were sensitive to information specifying emotional state as indexed by the word categorisation task. Compared to the effect of neutral expressions, facial displays of happiness, but not simulated facial displays of happiness, influenced the efficiency of word valence categorisation. It is important to note however, that in contrast to Experiments 1a and 1b, this effect was present without an explicit instruction to judge facial expressions or emotional state. In fact, in Experiment 2, participants were instructed to concentrate on a judgment task that appeared irrelevant to the facial displays presented and to ignore the facial displays.

The present study also included two artificial facial displays; control shapes, constructed by inverting the eyes and mouth of the neutral facial expressions; and composite smiles, constructed by superimposing the eye region of the posed smiles onto the genuine smiles. Created in this manner, the composite smiles essentially isolated the symmetry marker of genuine smiles in the absence of evidence for contraction of *orbicularis oculi* (i.e. the Duchenne marker).[84] The composite smiles were shown to influence positive word identification in a manner similar to that of the posed smile in that no differences in response latency were found between these conditions and the neutral expression condition. Although this could be taken as an indication that the Duchenne marker (i.e. contraction of *orbicularis oculi*) is the only useful indicator of positive affect present in static photographs of facial displays, a closer examination of the results of post-hoc testing indicates a second viable explanation. While the difference in time taken to categorise positive words preceded by the posed smiles was clearly not significantly different from those preceded by the neutral expressions (Tukey a, $p = 0.60$), the difference between the neutral expression and composite smile conditions approached significance (Tukey a, $p = 0.10$). Tentatively, it is suggested, that as an approximation of a low intensity genuine smile, the composite smiles were influential in terms of facilitating positive word identification, but not to the extent of the actual genuine smiles. This explanation is consistent with the findings of Frank et al. (1993) who reported that increasing the salience of markers of a genuine smile, especially the Duchenne marker, make these expressions more readily identifiable as being distinct from posed smiles. In this

[84] Although created artificially, there is potential for such an expression to occur in the context of actual social interaction. For instance, very low intensity genuine smiles may not show clear evidence of *orbicularis oculi* contraction, particularly in those who typically show little deformation of facial tissue and skin when facial muscles are contracted. In such cases, only the bilateral symmetry of the expression is available to inform the perception of emotional state. However, the constructed nature of these displays in the present study means that they cannot be treated as actual expressions.

sense, the genuine smile facial displays employed in the present research contained information specifying emotional state that was substantially more salient (i.e. the Duchenne marker) than the composite smile displays. However, no firm conclusions can be drawn from the present data. Hence the comparative effects of the Duchenne marker and the bilateral symmetry of genuine smiles await further investigation. It is suggested, however, that any future investigation be performed using valid actual facial displays rather than the artificially constructed expressions used here.

Furthermore, the control shape was intended as a baseline condition (as it contained the same features as the neutral expression, but arranged in a socially meaningless manner) to which the other conditions could be compared. As can be seen in Figure 3, the time taken to categorise positive words preceded by a control shape was the slowest of all conditions ($M = 647$ msecs), although not significantly different from that of positive words preceded by a neutral expression ($M = 632$ msecs). Positive words preceded by any of the three smile displays (composite smiles, posed smiles, or genuine smiles) were more rapidly identified in comparison to those preceded by the control shape. In the context of the present study this may be taken to suggest that all the smiles had a similar impact on word identification. However, the somewhat unusual nature of the control shape (the outline shape and general positioning of features were similar to a real face, only the internal detail was scrambled) may mean that the contrast between this display and the facial displays resembling positive expressions (i.e. the smiles) was simply enhanced, in that all the smiles were more similar to each other than any single smile was similar to the control shape. This explanation is supported by the comparison between the neutral expression condition and the smile conditions that exhibited the anticipated effects whereby the influence of the composite and posed smiles were similar to that of the neutral expression, while that of genuine smiles was not. Thus, it is suggested that the neutral expression condition is a more suitable basis to compare the impact of posed and genuine smiles than any artificially constructed control shapes that have no basis outside the laboratory context.

The results of Experiment 2 also revealed two significant interaction effects not directly related to the present study. Female participants were faster to categorise negative words than positive words, and also faster to categorise words preceded by a female facial display (or control shape constructed from the female neutral expression) than words preceded by a male facial display. Male participants did not show either of these differences. Both effects are consistent with previous research suggesting that females are more socially sensitive, emotionally expressive and accurate at detecting emotion compared to males (Ambady, Hallahan, & Rosenthal, 1995; Halberstadt, Hayes, & Pike, 1988; Kring & Gordon, 1998). In a survival sense, detection of negative events demands efficiency more than positive events, evidenced here by females' greater efficiency at identifying negative words than positive words. Males on the other hand, being generally less sensitive to such information, showed no such difference. Similarly, females are reported to be more emotionally expressive than males. Hence with female participants being both more sensitive to emotional expressions, and more expressive of emotion when compared to males, it would be expected, and indeed it was found, that female participants are more sensitive to female expressions of emotion than male expressions. Again, males, being less sensitive, did not display this difference. However, as noted earlier in this chapter, conclusions regarding any effects of sex pertaining to the facial displays need to be treated with caution as only one example of each sex was employed in the present study. Therefore, it is unclear whether the effects observed are necessarily reflective of a sex difference pertaining to the facial displays, or alternatively, an effect of the different individual faces unrelated to sex.

The present study provided novel empirical evidence to suggest that perceivers exhibit sensitivity toward the differences between posed and genuine smiles in a manner consistent with the ontological distinction between the expressions. Using a word categorisation task that had previously been shown to be influenced by affective facial expressions, it was demonstrated that posed and genuine smiles differentially impacted performance on this task. Furthermore, the nature of the effect of exposure to the facial expressions was consistent with that expected if perceivers do indeed have a tacit understanding of social significance of the difference between posed and genuine smiles. Positive words preceded by an expression of positive affect (i.e. a genuine smile) were identified more efficiently than when preceded by a neutral, emotionless expression. Importantly, simulated expressions of positive affect (i.e. posed smiles) did not have this effect, and in fact did not influence positive word identification any differently from the neutral expression. In this sense, it appears that posed smiles, in terms of underlying affect, were perceived in a manner consistent with the neutral expressions.

In addition, Experiment 2 provided a means to assess sensitivity to emotional state specified by facial expression without requiring participants to directly judge emotional state or any other related construct. Instead, performance on the word categorisation task was the explicit focus of the procedure, and thereby served as a performance index for measuring the effects of exposure to the facial expressions. Drawing from an ecological account of awareness (Gibson, 1979; Michaels & Carello, 1981; Reed, 1996) and E. J. Gibson's (1994) notion of prospectivity, it was predicted, and subsequently observed, that performance on the word categorisation task would systematically vary as a function of the facial expression preceding the word to be judged. However, an important caveat to the present study concerns the questionable ecological validity of the priming procedure employed. Although this study represents a substantive improvement on similar previous studies (e.g.Surakka & Hietanen, 1998; Williams et al. 2001) in that ecologically valid facial displays were employed (see Chapter 3), the laboratory context, including the distinct absence of an actual interaction, and the fact that static rather than dynamic facial displays were employed mean that the findings should not be directly generalised to interactive settings. Instead, the results of this study should be taken as a demonstration that social perceivers *can* be sensitive to smile veracity and the underlying ontological basis in emotional state, even in the absence of any direct instruction to judge, or attend to the nature of the facial expressions employed.

Taken in context with the literature reviewed in this and previous chapters, the results of Experiment 2 support the general consensus within these studies in that perceivers were shown to exhibit sensitivity to the meaningful differences between posed and genuine smiles. Using procedures ranging from explicit detection tasks (e.g. Experiments 1a and 1b, present research; Frank et al. 1993, study 1), to laboratory-based (e.g. Frank et al., study 2) and naturalistic impression formation studies (e.g. Scherer & Ceschi, 2000); mimicry studies (Surakka & Hietanen, 1998); eye-tracking studies (e.g. Williams et al., 2001) and priming studies (e.g. Experiment 2, present research), it has been repeatedly demonstrated that the social perceiver typically differentiates posed and genuine smiles in a manner consistent with the distinct emotional bases of these expressions.

To this end, evidence was presented in Chapter 1 to suggest that ontological distinctions pertinent to social interaction exist between posed and genuine smiles and are manifest in the information available for perception. Taken together, it is suggested that there are now grounds to consider smile veracity to be a potentially meaningful property of the social environment to which perceivers exhibit perceptual sensitivity consistent with such meaning. Thus, there appears to be sufficient evidence to enable consideration of the role of posed and genuine smiles in social interaction in terms of the monistic actor-environment relationship advocated as the unit of analysis for psychology by proponents of the ecological approach. In short, meaningful information, in the form of the invariant structure inherent to smile veracity is available to, and as demonstrated in Experiments 1a, 1b and 2, detectable by social perceivers. It now remains to identify what role, if any, such information plays in informing social interaction. The next chapter will report the final study in the present thesis, which was intended to provide an initial assessment of the affordance properties relevant to, and specified by, posed and genuine smiles.

CHAPTER 6

The Affordances Specified by Posed and Genuine Smiles

This chapter reports the third and final empirical component of the present research. Experiment 3 was designed to elaborate on the findings reported to this point by investigating the potential for posed and genuine smiles to play a functional role during social interaction. For proponents of the Gibsonian ecological approach to psychology, the detection of the dispositional properties of the creatures, objects, substances, places, and events of the environment is conceptualised in terms of the detection of the opportunities for acting or interacting relative to the individual perceiver, that is, the *affordances* of their environment (Gibson, 1979). Moreover, the affordances of other people, namely the *social affordances* of the environment, specify what can be done with, to, or by that person in relation to the perceiver. Thus, it was suggested in Chapter 2 that posed and genuine smiles, as information for social perception, specify categorically different sets of affordances. Genuine smiles specify the affordances of an individual experiencing a positive emotional state, while posed smiles, as facial expressions unrelated to emotional state, specify a distinctly different set of affordances that are likely to be related to the motivational intentions of the individual exhibiting the smile. The focus of the present research is on establishing whether social perceivers do in fact use the physiognomic information that differentiates posed from genuine smiles to guide their interactions with others.

Consistent with the Gibsonian commitment to a monistic unit of analysis for psychology (i.e. the animal-environment interaction), it is important to understand the informational properties of the environment in concert with the sensitivity of the perceiver to such properties before examining the reciprocal nature of these factors in regard to the detection of affordances. In this sense, Alley (1990) describes three fundamental questions intrinsic to a coherent ecological account of a psychological phenomenon, specifically: "1 What is the nature of the information available? 2 Do humans detect this information? 3 How is this information useful as a guide to behaviour?" (p.155). The previous chapters of this thesis have focussed on addressing these questions. With regard to the first question, in Chapter 1 literature was reviewed to suggest there are reliable and systematic physiognomic differences between posed and genuine smiles consistent with the ontological distinctions between these expressions. In brief, genuine smiles, that is smiles that occur in the context of a positive emotional experience, exhibit evidence of contraction of *orbicularis oculi* (i.e. the Duchenne marker), tend to be bilaterally symmetrical, and have a uniform duration. Posed smiles, on the other hand, do not occur in the context of happiness, do not involve contraction of *orbicularis oculi*, tend to be asymmetrical and occur over more variable durations. This suggests that posed and genuine smiles structure the optic array in distinctly different ways, specific to the ontological status of a given smile. Thus, it appears that there is information, structured by facial morphology, available to the perceiver that can specify psychodynamic properties, in this case whether a smiling individual is experiencing a positive emotional state or not. In addition, with respect to Alley's second question, the results of the empirical research reported in Chapters 4 and 5 indicate that social perceivers can in fact accurately distinguish posed from genuine smiles. When asked to judge whether a target individual was happy or not, perceivers reliably associated happiness with genuine but not posed smiles, regardless of whether judgments were made from photographs (Experiment 1a) or videos (Experiment 1b) of the target expressions. Furthermore, even without any explicit instruction to judge emotional state, perceivers were still sensitive to the meaningful differences between posed and genuine smiles as indexed by a behavioural priming task (Experiment 2). When considered together with the small body of relevant empirical literature reviewed in Chapters 4 and 5, these findings suggest that perceivers can typically differentiate between posed and genuine smiles in a manner consistent with the ontological basis of each respective expression.

Finally, in regard to the functionality of differentiating between posed and genuine smiles as a guide to behaviour, an argument was outlined in Chapter 1 that highlighted the importance of being sensitive to indicators of emotional state. To recap, it was posited that the social perceiver is well served by being able to accurately detect the emotional states of conspecifics. Emotions, when considered from a functional perspective, help individuals regulate their interaction with the environment in order to cope adaptively with the various contingencies they confront (Ekman, 2003; Frijda, 1986; Lazarus, 1991; Plutchik, 2003). Consequently, it may be advantageous for the social perceiver to be sensitive to information specifying the emotional state of an interaction partner as a means of knowing the dispositional properties of that individual. In regard to the present research, it has been argued that there is adaptive advantage for perceivers to be able to distinguish between posed and genuine smiles. While genuine smiles accurately specify disposition (i.e. a positive emotional state), posed smiles are unrelated to emotional experience and hence do not furnish perceivers with the same information regarding the dispositional properties of the smiling individual. Any failure to differentiate posed from genuine smiles may result in misperception of the emotional state of an interaction partner and, concomitantly, behaviour not appropriate to the situation. Sensitivity to the meaningful differences between posed and genuine smiles is therefore likely to provide an adaptive function for the social perceiver in a manner consistent with the general functionality provided by the accurate detection of the emotional states of others.

Thus, in regard to Alley's (1990) three fundamental questions described above, at this point it appears reasonable to conclude that: 1 There is information that specifies the ontological distinction between posed and genuine smiles; 2 Perceivers can be sensitive to this information; and, 3 Such sensitivity holds adaptive function. Taken together, this suggests that there is a basis to consider smiles as information for the perception of social affordances in a manner consistent with the general principles of ecological psychology. However, a deeper analysis is required at this point. An argument has been presented to the effect that smiles are valid candidates for ecological referents of disposition, specifically a positive emotional state in the case of genuine smiles, or alternatively, some specification of motivation or intention in the case of posed smiles. Furthermore, building on previous suggestions in the literature, in particular the work of McArthur and Baron (1983), it has been proposed that information specifying emotional states can be equated to information specifying social affordances (see Chapter 2). In this sense, it follows that there are categorically distinct sets of social affordances relevant to the dispositional properties specified by posed and genuine smiles.[85] Beyond this claim, it is necessary to stipulate more explicitly what the affordances of a happy individual actually are. In line with the

[85] It is difficult to define precisely what set of affordances any given posed smile may specify in that posed smiles are likely to relate directly to the intentions of the smiling individual. As these may range widely (e.g. a smile intended as a nonverbal greeting or as an intentional attempt to deceive), it is very important to understand the context in which these expressions are exhibited in order to understand the social affordances specified. However, at this stage it is sufficient to recognise that posed smiles *do not* specify the affordances of an individual experiencing a positive emotional state and therefore must instead specify a categorically different set of affordances when compared to genuine smiles.

functional accounts of emotion presented in Chapter 1, it has been argued that in an adaptive sense, discrete emotional states operate to help the individual regulate their interaction with the environment. For instance, experiencing fear when confronted by some form of danger is beneficial to the individual in terms of the provision of information regarding the nature of the situation (e.g. negative feelings of anxiety) and the facilitation of behaviours likely to assist in dealing with the danger (e.g. increased levels of physiological activity). Furthermore, in social contexts, communicating fear has several potential advantages ranging from a warning of danger to others, to an indication of submission or trepidation toward another person. In fact, many accounts of the specific evolutionary functions of the various emotional states have been posited in the literature (e.g. Ekman, 2003; Frijda & Mesquita, 1994; Keltner & Haidt, 2001; Lazarus, 1991; Levenson, 1999; Lewis & Haviland, 1993). The task for the present research is, therefore, to understand what the potential functions of positive emotional states are in order to describe the specific affordances of an individual experiencing such emotion, that is a genuinely smiling individual.

Social Affordances and the Function of Positive Emotional States

Within the literature that reports on the functional aspects of emotion, relatively little attention has been devoted to positive emotional states (Averill & More, 1993; Fredrickson & Branigan, 2001; Lazarus, 1991; Levenson, 1999). It is, perhaps, reasonably simple to conceive of some emotional states as having evolved in direct response to specific environmental contingencies or, as Lazarus has termed it, core relational themes. Fear, as mentioned above, helps mobilise the individual for escape, anger readies one to engage with a potential threat, disgust helps one avoid poisonous or other damaging objects and events, and so on. In turn, such explanations have received reasonable empirical support (e.g. Abe & Izard, 1999; Dimberg & Ohman, 1996; Lazarus, 1991; Plutchik, 2003). Happiness, on the other hand, has proven more difficult to conceptualise in terms of a specific adaptive benefit. There are few, if any, proximal threats to the survival of the individual that positive emotion may help overcome in the same direct manner as the other hypothesised primary emotional states (Fredrickson, 1998). Instead, functional theories of positive emotion have focussed on more general effects of such affective states on the well being of the individual. Commonly, positive emotion has been posited to facilitate approach behaviour and a general willingness to engage with the environment (e.g. Cacioppo, Klein, Berntson, & Hatfield, 1993; Davidson, 1993; Davidson, Ekman, Saron, Sehnulis, & Friesen, 1990; Ekman, 2003; Frijda, 1986). Lazarus (1991), for example, suggests that happiness occurs "when we think we are making reasonable progress towards the realisation of our goals" (p.267), and therefore results in continuation of the current activity (Carver & Scheier, 1990; Oatley & Johnson-Laird, 1987), or the facilitation of the exploration of novel aspects of their environment (Carver, 2003; Ekman, 2003). Presumably, these theorists would argue that in the absence of any particular threat, individuals without positive emotions would lack the motivation to spontaneously engage in novel or exploratory behaviour.

Consistent with these ideas, Fredrickson (1998; Fredrickson & Branigan, 2001) has proposed the *broaden-and-build* model, whereby positive emotions are believed to provide opportunities for the individual to accumulate and build resources. Fredrickson argues that positive emotions occur when the individual perceives that within their current circumstances they are safe and satiated.[86] These emotions result in the temporary broadening of, what Fredrickson has termed, an individual's *thought-action repertoire*, that is, the scope of their attention, cognition, and action. In support of this idea, Fredrickson cites evidence to suggest that a positive emotional state is accompanied by a widened focus of attention (e.g. Derryberry & Tucker, 1994), a heightened capacity for creativity (e.g. Isen, Daubman, & Nowicki, 1987), and more variation in the way familiar objects are used (e.g. Greene & Noice, 1988). In turn, this 'broadening' effect is said to serve the building of an individual's physical, intellectual, psychological, and social resources by facilitating activity conducive to developing such qualities. For instance, in many species including humans, play, an activity that often occurs in the context of a positive emotional state but rarely with negative emotions, has been shown to enhance predator avoidance and fighting ability (Boulton & Smith, 1992), which using Fredrickson's terminology is a physical resource. Similarly, positive emotion has been shown to facilitate mastery of tasks in 4-year-old children (Masters, Barden, & Ford, 1979), to enhance the strength of interpersonal relationships especially between caregivers and infants (Tomkins, 1962), to decrease cardiovascular demands (Gendolla & Kruesken, 2002), and to strengthen the immune system (Stone, Cox, Valdimarsdottir, Jandorf, & et al., 1987). These effects of positive emotion are said to contribute to the overall well being and general fitness of the individual. Thus, according to Fredrickson's broaden-and-build model, positive emotions serve adaptive function in that they provide opportunities to develop resources, in particular resources that are conducive to the achievement of goals and more generally survival, at times when such development is best achieved, that is when the individual is safe and satiated.

[86] This notion has obvious parallels with Lazarus' concept of goal realisation when safety and satiety are taken as generic goals. In this sense, perhaps happiness is best conceptualised as a *consequence* of perceived safety and satiety.

However, for the purposes of the present research, the function of positive emotion must be considered beyond the specific adaptive advantage provided to an individual. If, as suggested above, posed and genuine smiles specify different social affordances, the utility of positive emotion needs to be considered in terms of both the individual experiencing and expressing the emotion and the acquirer of information specifying this emotional state. What does the expression of a positive emotional state by an interaction partner offer to the perceiver of that state? In Chapter 1, a recent evolutionary theory put forward by Owren and Bachorowski (2001) regarding the functional origins of smiling in social interaction was reviewed. In brief, these authors proposed that smiling evolved in early hominids as a solution to a problem generic to group living: how to form and maintain reliable cooperative relationships without risking exploitation from others. Cooperation with conspecifics is a critical aspect of living in extended groups (Axelrod & Hamilton, 1981; Barkow, Cosmides, & Tooby, 1992), yet in theory, cooperative behaviour appears distinctly irrational (Kollock, 1998) or at least, somewhat risky (Colman, 2003). A willingness to cooperate may simultaneously serve as an opportunity for exploitation by non-cooperative others. To be successful, cooperation requires, by definition, reciprocity from an interaction partner. Thus, to ensure effective cooperation without exploitation, a reliable system of communicating cooperative intent must exist (Boone & Buck, 2003). Furthermore, this system must safe-guard against cheating, that is, not be susceptible to faked or false signalling of an intention to cooperate (Cosmides & Tooby, 1992).

Owren and Bachorowski (2001) proposed that smiling amongst humans has evolved to provide a mechanism to facilitate effective cooperation. Specifically, they suggested that the emergence of the smile as a reliable indicator of positive emotional state created simultaneous selection pressure for the ability to detect this indicator. An individual who could detect that an interaction partner was happy thereby enjoyed adaptive advantage over other individuals oblivious to such information. Further, detection of happiness engenders happiness in the perceiver (Surakka & Hietanen, 1998), which according to Fredrickson (1998; Fredrickson & Branigan, 2001), is adaptive in its own right. However, more importantly for interaction, this contagious nature of positive emotion fosters a feedback loop between interaction partners whereby detecting happiness leads to an individual experiencing and consequently expressing happiness, which, if in turn is also detected, elicits further happiness, and so on. Such feedback fosters positive affect between individuals, which according to Owren and Bachorowski's theory, sets the occasion for reciprocal cooperative behaviour. Indeed, as discussed above, positive emotion has been argued to foster general approach behaviour and engagement, activities conducive to interaction and cooperation. Importantly, this system of eliciting cooperation appears to incorporate a safe-guard against dishonesty or cheating. Simulations of happiness in the form of posed smiles are physiognomically distinct from spontaneous genuine smiles, providing a basis for the attuned perceiver to discriminate between legitimate cooperators and those attempting to elicit cooperation without intending to reciprocate. To this end, the results from Experiments 1a, 1b, and 2 from the present research suggest that perceivers can discriminate between posed and genuine smiles, while Surakka and Hietanen (1998) reported that viewing posed smiles did not bring about a positive emotional state in the same manner as viewing genuine smiles. Therefore, if, in the context of an interaction, happiness is not detected, whether it is because there is no information specifying happiness (i.e. a posed smile, or at least no genuine smile is exhibited) or either party to an interaction does not detect information that is present, then the feed-back loop is interrupted (or perhaps never begins) leading to a decrease in positive emotion and therefore a diminished likelihood of reciprocal cooperation. The propensity for social perceivers to mimic the facial expression and concomitantly the emotional state of conspecifics exhibiting genuine smiles, but not posed smiles (Surakka and Hietanen) provides a reliable means to identify, and be identified as a dependable cooperation partner. Thus, an interpretation of Owren and Bachorowski's theory is that genuine smiles, as expressions of positive emotion both specify and elicit opportunities for reciprocal cooperation. In other words, genuine, but not posed, smiles specify the affordance of *cooperability*.

Social dilemmas and the problem of reciprocal cooperation

In effect, Owren and Bachorowski's (2001) theory of the evolutionary function of human smiling posits a novel approach to elucidate an apparent illogicality of mutual cooperation during social exchange. Many aspects of sociality present the individual with a dilemma inasmuch as self-interest frequently conflicts with the interests of others. It is often the case in situations where some form of social coordination is required that individuals are better off acting in their own self-interest, rather than in the interests of others. For instance, choosing not to give a voluntary contribution to a local hospital allows one to save money, but probably does not affect the likelihood of receiving treatment from that hospital in the future given that others are likely to contribute. However, if all parties choose to behave in their own self-interests, then all will be ultimately disadvantaged. Without *any* donations there will be no hospital, a clear cost to all individuals of the society. Such conflicts between individual and collective welfare have been termed *social dilemmas*, that is, situations "in which...individually reasonable behaviour leads to a situation in which everyone is worse off than they might have been otherwise" (Kollock, 1998, p. 183) . More formally, Weber, Kopelman and Messick (2004) define social dilemmas by two characteristics:

> (a) at any given decision point, individuals receive higher payoffs for making selfish choices than they do for making cooperative choices regardless of the choices made by those with whom they interact and
>
> (b) everyone involved receives lower payoffs if everyone makes selfish choices than if everyone makes cooperative choices (p. 281).

Thus, social dilemmas present the individual with a literal conundrum: if they act in their own self-interests they risk foregoing any potential benefits accrued from acting cooperatively, however, if they act cooperatively they risk exploitation from others acting selfishly. If it is assumed that individuals generally act in rational, self-serving ways (Dawkins, 1989), it then presents as something of a puzzle as to how mutual cooperation in social dilemmas is ever achieved in light of the supposed individual irrationality required to forego the guaranteed gains of self-serving behaviour. Yet anecdotal evidence suggests that cooperative behaviour abounds.

Not surprisingly, social dilemmas have attracted interest from researchers across a wide variety of disciplines. Several generic theoretical mechanisms have been proposed to explain the phenomenon of cooperation in mixed-motive interactions. These have included biological explanations of kin selection (Hamilton, 1964) and reciprocal altruism (Trivers, 1971), economic approaches such as game theory (Luce & Raiffa, 1957) and the hypothesising of evolved, domain specific cognitive mechanisms for cooperating (Cosmides, 1989). Although a review of these theories is beyond the scope of the present thesis, it is important to note that common to them all is the notion that cooperation *can* be advantageous for the individual engaged in a social interaction if there is motivation to cooperate and fellow cooperators can be identified. If the reciprocation of a willingness to cooperate can be assured, then cooperation can become an individually advantageous strategy for social exchange (Caporael, Dawes, Orbell, & Van de Kragt, 1989; Colman, 2003; Cosmides & Tooby, 1992; Kiyonari, Tanida, & Yamagishi, 2000; Van Lange, Liebrand, Messick, & Wilke, 1992). In other words, to gain utility from cooperation, an individual must show a commitment to cooperate (Frank, 1988, 2001) and possess an ability to detect other committed cooperators (Boone & Buck, 2003) or at least an ability to detect those not committed, that is, to detect cheats or deceptive competitors (Andrews, 2002). Furthermore, it is suggested here that the hypothesised function of positive emotional states and smiling in social interaction proposed by Owren and Bachorowski (2001) serves as one (of a cluster) potential means for establishing reciprocal cooperation. The physiognomic distinctions between posed and genuine smiles provide information specific to cooperative intent inasmuch as a positive emotional state relates to a commitment to cooperate. Therefore, by attending to the facial expressions of interaction partners, social perceivers may gain insight as to who may make for reliable cooperators.

In fact, two previous studies have examined aspects of the impact of facial expressions on cooperative behaviour in the context of social dilemmas. Scharlemann, Eckel, Kacelnik and Wilson (2001) had participants play a trust game (a version of a social dilemma) with 'partners' represented by facial photographs. Each photograph depicted an individual exhibiting either a neutral expression or a smile, although no details regarding the veracity of the smile were available. These authors reported that compared to a neutral expression, smiling influenced trust in that cooperation rates were higher when interacting with a smiling 'partner'. They also reported that facial physiognomy affected cooperation independent of smiling. Some 'partners' were simply trusted more than others regardless of their facial expression. A second, conceptually similar, study on the effects of facial expression on cooperative behaviour was reported by Brown and Moore (2002). In this study participants took part in a resource allocation task (specifically a dictator game, another variation on the basic social dilemma theme), with interaction partners represented by cartoon icons depicting smiles. Importantly, the smiles were manipulated to resemble either a posed or a genuine smile by depicting the mouth as a symmetrical, upwardly curving line for the genuine smile, and an asymmetrical upwardly curving line for the posed smile. Brown and Moore reported that more resources were allocated when participants were interacting with partners represented by a symmetrically smiling icon, compared with those represented by an asymmetrically smiling icon. That is, greater cooperation was observed when interacting with a partner depicted as genuinely smiling.

The results of the study by Scharlemann et al. (2001) and the study by Brown and Moore (2002) are consistent with the general claim that smiling facilitates cooperation. However, major reservations regarding the ecological validity of the operationalisation of smiling interaction partners suggest the results of both studies should be interpreted with caution. In regard to the Scharlemann et al. study, without information regarding whether the smiles employed were posed or genuine smiles, it is difficult to know whether any type of smile will be likely to produce these results, that is, facilitate cooperation. It could be that the smiles employed by Scharlemann et al. were all posed, all genuine, or a mixture of both. In line with a main premise of the present research, that is posed and genuine smile specify categorically distinct sets of affordances, it is imperative that smile veracity be considered before claims regarding the role of smiles in social interactions can be verified. In addition, the smiles employed by Brown and Moore, while theoretically sound in regard to the nature of some of the information differentiating posed and genuine smiles, simply do not meet the criteria for ecologically valid facial displays (see Chapter 3). Line drawings do not sufficiently recreate the information available to the perceiver in the context of an actual interaction and therefore have little generalisability beyond the experimental setting. Furthermore, facial symmetry has been shown to be related to perceptions of attractiveness (Zebrowitz, 1997), and attractiveness has been shown to influence cooperation in dilemma settings (Mulford, Orbell, Shatto, & Stockard, 1998). It could be that attractiveness rather than smile veracity was responsible for the results reported by Brown and Moore, although questions about whether faces represented by line drawings are perceived as attractive need to be considered before this conclusion can be drawn.

To this end, the major objective for the present study is to provide a conceptual replication of the Scharlemann et al. and the Brown and Moore studies in order to further investigate the function of smiling in social dilemmas. In addition, an emphasis of the present research is on the ecological validity of the experimental procedure, and in particular, the facial displays employed. The remainder of this chapter reports the final study in the present research that was designed to provide an initial empirical evaluation regarding the function of smiles in social dilemma situations.

The Present Research

The goal of the third and final study in the present research was to examine the potential functional role sensitivity to the meaningful differences between posed and genuine smiles plays in the context of social interaction. Evidence has been presented to suggest that posed and genuine smiles differ physiognomically in a manner consistent with the ontological basis of these expressions. Furthermore, experimental evidence from the present research has indicated that perceivers are in fact sensitive to this distinction. In regard to the present research, what remains is to illustrate the specific function such sensitivity offers to the perceiver. It has been suggested, based on a recent evolutionary account of smiling in social interaction (Owren & Bachorowski, 2001), that when confronted with a social dilemma, sensitivity to smile veracity provides a means to reliably distinguish between cooperative and non-cooperative interaction partners. The present research was designed to test this claim by examining cooperative behaviour as a function of the facial expressions of interaction partners in the context of a social dilemma, specifically the Prisoners' Dilemma.

The Prisoners' Dilemma

Common to the voluminous body of literature that has examined various aspects of social dilemmas is a focus on one particular example of a dilemma, the Prisoners' Dilemma (see Table 7). The Prisoners' Dilemma was developed in the early 1950s by Merrill Flood, a social psychologist, and Melvin Dresher, an economist, to test predictions derived from game theory. It was later formalised by Albert W. Tucker, a mathematician who constructed a description of the dilemma from which the name resulted (Luce & Raiffa, 1957).

Table 7: Sample payoff matrix for the prisoners' dilemma showing the payoff (i.e. jail sentence) for Prisoner A.

	Prisoner B	
Prisoner A	No confession	Confession
No Confession	1 year	10 years
Confession	None	9 years

In short, Tucker described a situation in which two prisoners had been charged with a crime and were being held in separate cells while awaiting trial. Each prisoner is offered a choice to either confess or not confess to the crime; however no communication between the prisoners is possible. The prosecutor informs the prisoners that without a confession, there is only enough evidence to convict them of a lesser crime, which attracts a jail sentence of 1 year. However, each prisoner is also offered a deal whereby if they confess and their accomplice does not, they are able to go free, while the other prisoner will be convicted and sentenced to 10 years in prison. However, if they were to both confess, then there would be no opportunity for a deal and both would go to jail for 9 years. Herein is the dilemma. If we consider the situation from the point of one prisoner[87] (called prisoner A), it is a logical fact that prisoner B will either confess or not, these are the only two options available. In fact, regardless of how prisoner B acts, prisoner A will always be better off, that is receive fewer years in jail, by confessing. Hence, if rational, prisoner A will minimise potential years in jail by confessing. Furthermore, the same reasoning applies equally

[87] The Prisoners' Dilemma features a symmetrical payoff structure hence the dilemma is identical regardless of which of the two prisoners is considered.

to prisoner B, who should, if also rational, also confess. Thus, rationality on the part of both parties leads to a mutually costly situation with both prisoners spending 9 years in jail. Compared to the alternative of neither prisoner confessing which results in only 1 year in jail each, the supposedly rational strategy of always confessing now appears distinctly irrational. In an identical manner to the more general description of social dilemmas given above, the Prisoners' Dilemma provides a context whereby behaviour that favours the individual leads to a less than optimal outcome for all parties involved (see Appendix M for a description of the general form of the Prisoners' Dilemma).

The Prisoners' Dilemma has since been the subject of a great deal of research, resulting in several thousand studies (Kollock, 1998). Primarily, the Prisoners' Dilemma has been employed as a simulation of the generic social dilemma situation so as to attempt to understand how cooperation is achieved in light of the apparent costs associated with not acting selfishly. Although the ecological validity of using games such as the Prisoners' Dilemma to model social exchange has been questioned (e.g. Liebrand, Messick, & Wilke, 1992), a number of 'natural' situations have been identified that comply with the general form of the Prisoners' Dilemma (see Appendix M). For example, the practice of blood sharing among vampire bats (*Desmondus rotundus)* closely resembles a prisoners' dilemma situation. Among adults of this species, around 8% fail to find food on any given night of hunting (Wilkinson, 1984), a potentially costly failure in that food deprivation in this species leads to starvation within 48-72 hours (McNab, 1973). However, unsuccessful hunters are often fed regurgitated blood by successful roostmates, particularly when there is an opportunity for future reciprocation (i.e. the recipient has not refused to regurgitate in the past, hence is likely to reciprocate in the future). Brembs (1996) suggests that this is a dilemma situation in that the successful hunter is faced with the options of not feeding an unsuccessful conspecific and therefore conserving resources for itself to safeguard against future shortages of food (i.e. competitive behaviour), or feeding the unsuccessful individual thereby losing resources, but gaining the potential for future reciprocation (i.e. cooperative behaviour). Selfish behaviour advantages the individual, but if all individuals behave selfishly then the entire population is disadvantaged. Brembs also described parallel examples of dilemma situations applying to lycaenid-ant interactions, predator inspection in some fish species, egg-sharing amongst hermaphroditic seabass, and coalition formation in several primate species. In short, the constraints inherent to the Prisoners' Dilemma match well the constraints that apply to general dilemma situations as they occur in the natural environment of social exchange.

To this end, it is suggested that the Prisoners' Dilemma offers a suitable methodological tool for the present study in that it provides a structure for social exchange consistent with the conditions specific to social dilemmas. The binary options to either confess or not confess in the Prisoners' Dilemma equate to the more generic behavioural categories of cooperation and competition common to all social dilemmas. Hence, when playing the Prisoners' Dilemma, the behaviour of individuals is constrained to either competing or cooperating with their interaction partner. This constraint provides a means to examine the proposed affordances specified by posed and genuine smiles in that participants are required to choose their preferred form of interaction (e.g. either competition or cooperation) within a reasonably realistic social exchange scenario. Thus, by requiring participants to play the Prisoners' Dilemma with a partner exhibiting either a posed or a genuine smile, the influence of these facial expressions on cooperative (and competitive) behaviour can be examined while maintaining an appropriate degree of experimental control that is not plausible if more naturalistic social interactions were observed.

A further advantage of employing the Prisoners' Dilemma as a methodological tool for the present research relates to the large body of research that has been conducted in this area. A lot is already known about various factors that influence behaviour in laboratory-based Prisoners' Dilemma situations. Although a review of this literature is beyond the scope of the present thesis, it is necessary to briefly canvass those aspects of the past research that may be applicable to the present study. In particular, it is important to note factors relevant to the current research that have been shown to influence cooperation in dilemma situations. Overall, typical cooperation rates in experimental dilemma situations are between 30% and 40% (Komorita & Parks, 1995; Sanna, Parks, & Chang, 2003). These rates apply to dilemma situations whereby individuals have no opportunity to interact. However, once some form of interaction is available, cooperation is enhanced. Based on a meta-analysis of 130 studies conducted between 1958 and 1992, Sally (1995) reported that when all other factors were controlled for, an opportunity to have a conversation with interaction partners prior to taking part in a dilemma situation increased the likelihood of cooperation by approximately 45%-50%, while eye-contact alone resulted in a 20% increase in cooperation rates. To illustrate, a study conducted by Wichman (1970) had participants playing dilemma games in one of four conditions: isolation (i.e. no contact at all with partner); visual contact (i.e. could see but not hear partner); aural contact (i.e. could hear but not see partner); and full contact (i.e. could see and hear partner). The results revealed that the degree of contact was positively related to cooperation in that the median cooperation rates reported were 41%, 48%, 72% and 87% for each condition respectively. Thus, given that the present design requires face-to-face contact between the participant and their interaction partner, it is expected that cooperation rates in the present study will exceed the typical rate of between 30-40% reported for dilemma situations where face-to-face interaction is not possible (Komorita & Parks, 1995; Sanna, Parks, & Chang, 2003). Furthermore, the structure of the payoff matrix has been found to influence cooperation such that in a prisoners' dilemma situation where 'A' represents a cooperative choice, and 'B' a competitive choice and K = (AA payoff – BB payoff) / (BA payoff – AB payoff), the value of K approximates typical cooperation rates (Rapaport, 1967). For example, a matrix with $K = 0.5$ predicts a cooperation rate of approximately 50%, all else being equal[88] (Sanna et al., 2003).

Additionally, individual differences in the personalities of the players has been shown to strongly influence cooperation rates in dilemma situations. The major dimension explored in this regard has been termed the *social value orientation* of an individual (Messick & McClintock, 1968), which can be defined as "stable preferences for certain patterns of outcome for oneself and others" (Van Lange, Otten, De Bruin, & Joireman, 1997, p. 733). In other words, this dimension is assumed to reflect variation between individuals' predispositions to approach social dilemmas cooperatively or competitively (Van Lange & Kuhlman, 1994). In this sense, Deutsch (1960) established a typology of social value orientation whereby individuals can be categorised into one of three orientations, namely: cooperators, individualists, and

[88] This applies to an anonymous dilemma situation where nothing about interactions partners is known.

competitors. Basically, cooperators[89] prefer to maximise gain for both themselves and their partner, individualists prefer to maximise gain for themselves with no regard for their partner, and competitors prefer to maximise their relative gain compared to their partner. In the context of a social dilemma, social value orientation has been shown to influence cooperation rates. Cooperators exhibit more cooperative behaviour than do individualists, who in turn cooperate more than competitors (Kuhlman & Marshello, 1975; McClintock & Liebrand, 1988; Sally, 2000; Van Lange et al., 1992). The robustness of these findings (Van Lange, 1992) suggests that the social value orientation of the participants in the present study should be taken into account.

Perceptions of interaction partners have also been shown to influence cooperative behaviour in dilemma situations. Cooperation rates have been demonstrated to be positively related to the perceived similarity of an interaction partner's attitudes (Van Lange, 1992), shared group identity with an interaction partner (Kramer & Brewer, 1984), prior friendship or liking of an interaction partner (Swingle & Gillis, 1968), and perceived attractiveness of the interaction partner (Mulford et al., 1998). Finally, mood (e.g. Sanna et al., 2003) and sex (e.g. Orbell, Dawes, & Schwartz-Shea, 1994) have also been studied in relation to behaviour in dilemma situations, however any systematic pattern within these results is not clear and perhaps the outcome of complex interactions between relevant variables (Van Lange et al., 1992). Overall, it has been demonstrated that many factors influence cooperative behaviour in Prisoners' Dilemma scenarios, which must in turn be considered and accounted for, in the design of the present study.

[89] Cooperators are also often referred to as prosocial individuals (Van Lange & Kuhlman, 1994).

Experiment 3

The purpose of the third experiment in the present research was to investigate the affordances specified by posed and genuine smiles in social interaction by using the Prisoners' Dilemma as a device to structure interactions. Based on the work of Owren and Bachorowski (2001) it has been proposed that genuine smiles, as spontaneous expressions of a positive emotional state, specify an opportunity to cooperate, that is, the affordance of cooperability. In order to test this proposition, participants were required to play a number of dilemma games with 'partners'. These partners were ostensibly other participants although in reality were never actually present, but represented in a manner such that the participants themselves believed they were engaging in genuine interactions. The focus of these games was a series of Prisoners' Dilemma trials where the partner was represented using digital video clips of facial displays, specifically neutral expressions, posed smiles, and genuine smiles. This procedure provided the means to investigate whether cooperative behaviour varied as a function of smile veracity, and in effect, an initial assessment of the plausibility of the postulation that genuine, but not posed smiles, specify the affordance of cooperability. Specifically, following Owren and Bachorowski, it is suggested that if a participant is interacting with an individual exhibiting a genuine smile, they are exposed to information specifying a positive emotion state, which, if detected, facilitates positive emotion in the participant and leads to an increase in the likelihood of cooperation. However, if the interaction partner is expressing a posed smile, there is no information available specifying positive emotion, and therefore, if perceived accurately, no elicitation of positive emotion in the participant, and therefore no effect on the likelihood to cooperate.

Furthermore, a number of relevant factors identified from past research to influence cooperation in social dilemma situations were taken into account in the present study. Specifically, although factors related to the perception of interaction partner characteristics (e.g. perceived attractiveness, shared group identity, perceived similarity of attitudes) were not assessed directly, comparison between rates of cooperative behaviour for interactions with the *same* partner ensured that the influence of such perceptions was reasonably constant. In addition, the social value orientation of each participant was measured at the beginning of the procedure, while mood was measured by self-report throughout the procedure. The facial expressions of each participant were also recorded throughout the Prisoners' Dilemma portion of the procedure in order to provide an assessment of the relationship between participant genuine smiling and cooperative behaviour. According to Owren and Bachorowski (2001), the detection of positive emotion state in others facilitates the experience of positive emotion (which may be manifest as genuine smiling), and in turn the likelihood of cooperation. By recording participants' facial expressions in addition to their competitive and cooperative choices in the Prisoners' Dilemma scenario, a more comprehensive evaluation of Owren and Bachorwoski's selfish gene theory of smiling in human interactions can be conducted. Finally, only female participants will be recruited in order to reduce the complexity of the experimental design.

Thus, in line with the arguments developed to this point, it is predicted that the cooperation rate for interactions with a genuinely smiling partner will be significantly greater than for interactions with a partner exhibiting a posed smile.

Method

Participants.

Participants in Experiment 3 were 30 female students recruited from the University of Canterbury. Participants' ages ranged from 17 to 29 years with a mean age of 20.4 years (*SD* = 3.5). Upon completion of the procedure each participant received a $15 voucher redeemable at campus stores. One participant's data was not included in the present analysis due to an equipment failure that was not detected until after the completion of the procedure.

Facial displays.

Three facial displays were selected from 3 of the 13 individuals who participated in the facial display generation procedure described in Chapter 3. All three individuals whose facial displays were employed were female in order to reduce the complexity of the present design (i.e. sex differences were not investigated). For two individuals a neutral expression, a posed smile, and a genuine smile were selected. Of these two, one set of displays featured only closed mouth smiles, while the other featured only open mouth smiles (for each individual the intensity of their expressions was matched according to FACS criteria, see Chapter 3). Given that the results of Experiments 1a and 1b indicated that perceivers were inclined to judge open mouth smiles in a more biased fashion (i.e. were more likely to judge an open mouthed than a closed mouth posed smile as reflecting happiness), it is important to keep this variable constant within a given individual's facial displays. Furthermore, for the third set of facial displays a neutral expression and two posed smiles, one with the mouth open and the other with the mouth closed were selected (hence the intensity of these expressions were not equivalent, the closed mouth smile was a less intense expression than the open mouth smile by one step on the FACS criteria for intensity). This enables a direct comparison between cooperation rates for open and closed mouth posed smiles to be made and therefore provides the opportunity to determine whether exposure of the teeth influences the attainment of cooperation in dilemma situations.

Materials.

Social value orientation was measured using a series of decomposed games (Messick & McClintock, 1968) that were adapted from Van Lange et al. (1997). These games required participants to choose between three alternate options that involved dividing resources (i.e. 'points' that the participants were told equated to money) between themselves and an interaction partner (see Appendix N). Each of the three options corresponded to either a cooperative choice (i.e. maximal gain for both the participant and the partner), an individualistic choice (i.e. maximal gain for the participant independent of the outcome for the partner), or a competitive choice (i.e. maximal gain for the participant relative to the gain for the partner). For example, participants were shown a practice game whereby they were required to choose between 500 points for both themselves and their partner, 550 points for themselves and 300 points for their partner or 500 points for themselves and 100 points for their partner. The first option was the cooperative choice (i.e. 500 + 500 = 1000, the greatest joint gain), the second the individualistic choice (i.e. 550 > 500, therefore the greatest individual gain), and the third the competitive choice (i.e. 500 – 100 = 400, the greatest relative gain). Each participant was categorised as cooperative, individualistic, or competitive if, of the nine decomposed games presented, they choose at least 6 options from the same category. Participants who did not meet this criterion were not categorised in regard to social value orientation. This approach to measuring social value orientation has been reported to have adequate internal consistency (Liebrand & Van Run, 1985) and test-retest reliability (Kuhlman, Camac, & Cunha, 1986), and has been shown to be unrelated to mood or social desirability (Van Lange et al., 1997). Furthermore, Van Lange, Agnew, Harinck and Steemers (1997) reported that social value orientation, when measured using decomposed games, has good predictive validity of behaviour across a range of real-world dilemma situations, and thereby claimed that both the construct and the measurement tool possess a reasonable level of ecological validity.

Participants were also required to play a resource dilemma game (a form of the general social dilemma situation) adapted from Bargh, Gollwitzer, Lee-Chai, Barndollar and Trotschel (2001), which was administered using a computer program written specifically for this task (Walton, 2003b). In this task, the participant and a partner (simulated by the software) were able to gain resources from a common pool that was replenished periodically. The participant never knew how much resource the partner had taken, hence the dilemma was that if they took the maximum amount possible, the resource would be depleted more quickly than if they exhibited some restraint and harvested less than they were able to. Participants were supplied with written instructions (see Appendix O) regarding this task including a table that outlined the effect of various sized harvests on the resource pool. Further details of this task are provided in the procedure section below.

The Prisoners' Dilemma task was also administered by computer using software written for Experiments 1 and 2 and adapted for the present purpose (Walton, 2004). Participants were provided written instructions for this task (see Appendix P) that included the payoff matrix and a brief description of the nature of the dilemma itself. Further details of this task are also provided in the procedure section below.

At various stages during the procedure participants were also required to rate their mood on analogue mood scales (see Appendix B). Mood was scored by measuring the distance (in mm) from the centre point of the scale marked 'Neutral', to the line made by the participant. Thus, mood scores could potentially range from -100 (very negative) to 100 (very positive).

Apparatus.

The resource dilemma and Prisoners' Dilemma tasks were administered using a PIII 650 mHz personal computer running Windows XP Professional, a standard 17-inch colour computer monitor, and customised software (Walton, 2003b, 2004). During the Prisoners' Dilemma task, video-recordings of the participant's face were made using a Canon XM2 3CCD digital video camera mounted above the computer monitor. The recordings were subsequently converted to digital computer files using Adobe Premier software. Each recording was captured in PAL format at 25 frames per second, standardised for brightness and contrast, and compressed using a Microsoft MPEG4v2 codec.

Design.

This experiment employed an entirely within-participant design. All participants completed all parts of the procedure. With the exception of the Prisoners' Dilemma task the order of tasks was standardised across all participants. For the Prisoners' Dilemma task, the order of facial expression presentation was partially randomised.

All participants saw all three neutral expressions first; however the order of the individual facial displays was randomised. Following this, participants saw six different facial displays (2 displays from 3 individuals) in a random order.

Procedure.

It was imperative to the validity of this experimental procedure that participants accepted as true the presence of their simulated interaction partners. Participants were told that they were taking part in the experiment simultaneously with three others, with whom they would be interacting in various ways. Although the other participants were never actually present, it was crucial that participants believed they were interacting with other individuals. If participants did not accept this cover story, they may not have behaved as they would when actually interacting with others. To this end, the purpose of the initial tasks in the procedure was to help establish credibility of the cover story, as well as to collect baseline information regarding participants' propensity for cooperation and competition in social dilemma situations.

Participants were recruited to take part in a study entitled "Social Psychology and Cyberspace: Communicating across the Internet". Upon arrival to the laboratory they were greeted and provided with an information sheet (see Appendix Q) and given a verbal description of the research. Specifically, participants were told that they would be taking part in research that was investigating various aspects of interpersonal interaction when using new technologies such as the internet, web-cameras, and video-conferencing. It was explained that an initial motivation for the research was to understand how communication between individuals has been shaped by the advent of new technologies and an example was given of how it is now possible to hold a face-to-face interaction with another person who is not in the same physical location, by using web cameras. Finally, it was explained that the research involved several tasks that examined communication and interaction in different settings, some which involved a computer interaction and others that did not, and therefore, three other participants would be completing the experiment as well. All participants were then asked to sign a consent form (see Appendix R) if they agreed to take part.

Once consent was obtained, it was explained that the experiment consisted of three interaction tasks and a number of short questionnaires, and the interaction tasks would take place with the other participants who were located in separate testing rooms in the Department of Psychology. Participants were also informed that they would be paid between \$5 and \$25 for taking part in the experiment, but that the amount they would receive depended on their performance in the interaction tasks. Specifically, they were told that in each interaction task there was a chance to earn 'points' and that at the completion of the experiment their points would be converted into money. Furthermore, they were also told that their performance in each interaction task depended partly on their own responses and partly on the responses of their partners.

Initially, participants were required to complete a mood scale (see Appendix B) and were then provided with an information sheet and response form regarding the social value orientation scale (see Appendix N), ostensibly the first interaction task. It was explained that this task involved interaction with one of the other three participants, although they would not know who the other participant was. Their interaction partner was, in relation to the decomposed game, the 'other' person who they were assigning points to. It was also explained that the 'points' for each participant in this task would be calculated by taking an average of the points they assigned to themselves and the points their partner assigned to them, which would then be converted into a monetary amount that they would be paid at the end of the experiment.

Participants were next required to complete a second mood scale (see Appendix B) and then provided with written instructions regarding the resource dilemma task (see Appendix O). The resource dilemma task was introduced as the second interaction task, whereby they would again be interacting with one other participant, but they would not know whom it was. Participants were told that this task was similar to the previous one in that the more resources they accumulated the more money they received and that their performance also depended partly on their own responses and partly on the responses of their partners. The instructions outlined that the participant was to take the role of the captain of a fishing boat that was licensed to catch fish from a small lake. They were told that only their boat and one other (that of their interaction partner) were allowed to fish from this lake which began with a stock of 100 fish, but only on the condition that the number of fish in the lake never fell below 70 (if this occurred they lost all the fish they had previously harvested). Participants were also told that each season they caught 15 fish and their task was to decide how much of this catch to keep, and how much to return to the lake. They could keep between 0 and 15 fish, but the more fish they kept the fewer would be in the lake for breeding, and therefore, fewer would be available the subsequent season, while the more they returned, the more that would be available in the future. A table was supplied that listed the consequences of keeping fish versus returning fish to the lake (see Appendix O). The table followed the equation $L = 5n - 30$ (Bargh et al., 2001), where L represents the effect on the lake and n represents the number of fish returned in a season (e.g. keeping 10 fish and returning 5 to the lake had a net effect of decreasing the lake stock by 5). Participants were told that there was no set number of seasons, but if the number of fish in the lake ever dropped below 70, then the game was over and they would lose all the fish they had kept to that point. They were also told there was no means to communicate with the other player, and therefore, no way to know how many fish the other participant were keeping, and how many they were returning to the lake. Finally, they were told that the total number of fish they accumulated would be converted into a monetary amount that they would be paid at the end of the experiment.

Before beginning a practice trial the experimenter made a bogus telephone call to one of the other experimenters who was administering the task to the interaction partner. This call was allegedly made to check if the other participant was ready to begin the resource dilemma procedure, but was actually a set part of the procedure to help maintain the cover story. Participants were then shown into a separate testing room where the computer and monitor were situated. Phoney cables were run from the computer into an adjoining room that participants were told provided a direct connection to the other testing rooms. For each fishing season, an initial catch of 15 fish was displayed in the centre of the computer screen. Participants were then required to press designated keys to adjust the total number of fish they wished to return to the lake. Also displayed was the effect the participant's decision would have on the stock of the lake as well as the total number of fish accumulated over all seasons. Each season lasted 30 seconds, during which a tone was played at a random time that participants were told indicated that their partner was 'online and fishing'. At the completion of each season the message: "there continue to be more than 70 fish in the lake" was displayed regardless of how many fish participants chose to return. Five fishing seasons were played in total, with the number of fish participants elected to retain each season recorded by the computer software.

After finishing the resource dilemma task, participants completed a third mood scale and were then introduced to the final interaction task, the Prisoners' Dilemma. It was explained that in this task, interaction would be taking place with all 3 other participants, again using a computer, but this time they would be able to see and be seen by the others via a video camera and web link. Written instructions for the Prisoners' Dilemma were supplied which included the payoff matrix and a brief explanation of the logic behind the dilemma (see Appendix P). These instructions were repeated verbally to the participants after which a short practice game of the dilemma was played between the participant and the experimenter to ensure the payoff structure was fully understood. After this, the experimenter provided some further details regarding the procedure by referring to a fake chart on a wall adjacent to where the participants were seated. Specifically, participants were told that the experiment had several different conditions and manipulations, and that in the current condition, they would be interacting with members of the same sex (i.e. female) who had been recruited from different departments of the university so it was unlikely they would know them. They were also told that the web-camera link was video only (i.e. no sound), only one-way at a time (i.e. while they were watching their partner they could not be seen and vice-versa), and as a result one participant would always be seen first, one would always see their partner first, and the other two would oscillate between being seen first or second. Participants were informed that they had been allocated to the role whereby they would always see their partner first and then be seen by that person. This information was provided to prevent any suspicion regarding interaction order (i.e. the fact the interaction partners were always seen first) and to minimise the likelihood that participants would attempt to communicate verbally via the video-link as this may have aroused suspicion regarding the actual presence of their partners when they did not respond. No mention was made of competition, cooperation, or the Prisoners' Dilemma at any stage of the procedure. Participants were reminded that this task was similar to the previous two in that the more points they accumulated the more money they would be paid at the end of the experiment, and that their performance was determined in part by their own responses and in part by their partner's responses.

Participants were then shown back into the testing room, the video camera was positioned above the monitor and additional cables were plugged into it. Although the camera primarily served to maintain the cover story, it was also used to record the participant's facial expressions during the course of the procedure. A mirror was positioned behind the participant such that a reflection of the monitor the participants were using could be seen on the recording of the participant's facial expressions. This provided a record of the order of interactions with each partner. Each trial began with a screen of text simulating computer traffic (e.g. establishing network connections, selecting interaction partner etc.) for approximately 5 seconds followed by an on-screen countdown that participants were told signified that a video transmission was about to begin. After the countdown was complete, a 10-second video-clip of a facial display of one of the interaction partners was displayed. Once the video-clip of the interaction partner had finished, further simulated computer traffic appeared on screen, followed by another count-down and a 10-second test pattern which the participants were told signified that they could be seen by their partner. Finally, a further screen of simulated computer traffic was displayed followed by an opportunity for the participant to make their response. Each trial was completed once the participant had made their response, which was recorded by the computer software.

In an initial practice trial, instead of a video clip of a participant, a 10-second video was played showing an empty testing room identical to that the participant was in. At this point the experimenter apologised and claimed that this must mean that the other participant was not ready. The experimenter then made another bogus telephone call, apologised again and assured the participant that their partner was now ready to begin. The procedure began with a series of 3 trials whereby the participant interacted once with each partner displaying a neutral expression. The participant was told that these trials, although part of the procedure and therefore worth points, were calibration trials to ensure the equipment was working properly and that the cameras were correctly positioned and focussed. As such, for these trials they were told that during transmission it was important that they sit still and look directly into the camera. This information was intended to reinforce the cover story and reduce suspicion regarding the rather solemn appearance of the interaction partners exhibiting neutral expressions. It was also important to show the neutral expressions first as interspersing these expressions with the smiles may have led participants to make attributions regarding this change in expression of their partners and therefore influence their responses, or worse, potentially arouse suspicion about the procedure. After these trials were completed the experimenter reported that all the equipment appeared to be working correctly and asked the participant whether they could see their partners clearly, whether they had interacted with three different people and if they knew any of them personally. No participants knew any of the interaction partners. The experimenter then informed the participant that there would be six further interactions (in effect the six critical smile trials), two with each partner, and that because everything was working correctly, they could now relax and act more naturally during the interactions. This provided a credible reason as to why the interaction partners were smiling in the following interactions.

After the Prisoners' Dilemma task had been completed, participants were required to fill out a fourth mood scale, and a debriefing questionnaire (see Appendix S) designed to discover whether the participants believed the cover story and deceptions involved in this procedure. No participants questioned the actual presence of the interaction partners, or reported any suspicion regarding the cover story for the experiment, or the experimental procedure per se. Participants were then debriefed as to the actual purpose of the experiment (see Appendix T). Finally, participants completed a fifth mood scale and a second consent form (see Appendix U) after which they were paid (all participants received $15 regardless of performance) and thanked for their time and assistance. Participants were asked to not discuss the experiment with others for at least one month to prevent the cover story being exposed. The entire procedure lasted approximately 1 hour.

Results

The main dependent measure of interest in this experiment was the nature of the choices (i.e. cooperative or competitive) made by participants in the Prisoners' Dilemma task, expressed as a rate of cooperation (i.e. number of cooperative choices / total number of interactions). The overall cooperation rate for all interactions was 0.57

(SD = 0.23). This rate is consistent with that expected for the payoff matrix used in this task (K = 0.5, therefore 50% cooperation was expected, all else being equal), in light of the previous findings that social contact (e.g. eye contact) between interaction partners facilitates cooperation in dilemma tasks (Sally, 1995). The remainder of this results section will provide an examination of the factors influencing cooperation rate in Experiment 3. The primary focus of this study was to investigate the influence of smile veracity on cooperation rates. However, to do so, account must be taken of impact of the factors relevant to the present study that have previously been shown to influence cooperative behaviour in social dilemma situations, in order to be able to examine whether smile veracity has an effect in addition to these variables. Therefore, initially the relationship between each of the variables measured and cooperative behaviour will be explored in a univariate manner. Subsequently, those factors shown to be relevant to cooperation in the initial analyses will be combined into a multivariate analysis in order to further assess any relationship between cooperation and partner facial expression while controlling for the influence of all other relevant factors. In this way, any influence of interaction partner facial expression on cooperation in addition to that of the other factors shown to be related to cooperative behaviour can be examined.

Facial expression of partner.

Cooperation rates as a function of facial expression are displayed in Figure 4. The influence of the interaction partner's facial expression on cooperation was initially examined using a one-way repeated measures analysis of variance comparing the cooperation rates for interactions with partners expressing neutral expressions ($M_{neutral}$ = 0.62), posed smiles (M_{posed} = 0.50), and genuine smiles ($M_{genuine}$ = 0.66). This revealed a significant effect, $F(2,56) = 3.11$, $p = 0.05$. A planned comparison revealed that participants cooperated when their interaction partner was exhibiting a genuine smile significantly more frequently than when they were exhibiting a posed smile, $F(1,28) = 4.42$, $p < 0.05$. Similarly, more cooperation was observed when the partner exhibited a neutral expression than when they expressed a posed smile, $F(1,28) = 4.08$, $p = 0.05$, but there was no difference in cooperation rate when neutral expression and genuine smile interactions were compared, $F(1,28) = 0.31$, *n.s.*

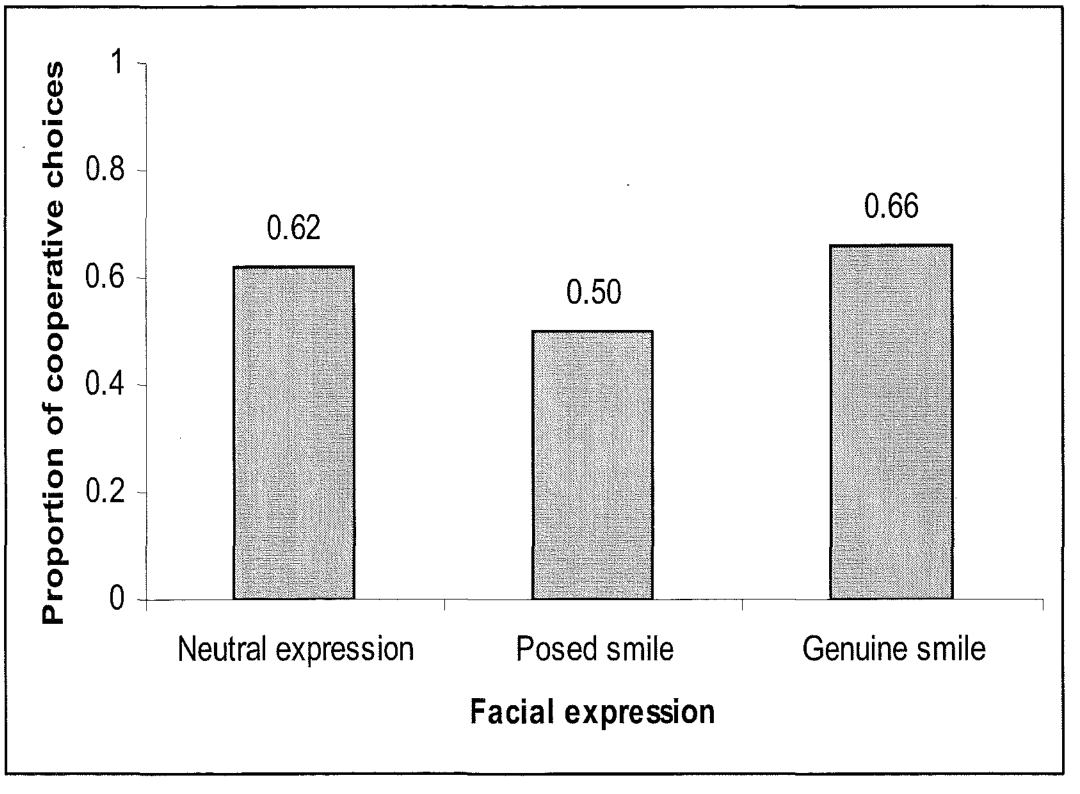

Figure 4: Bar graph showing the cooperation rate as a function of interaction partner's facial expression, Experiment 3.

Cooperation as a function of facial expression was also examined for each interaction partner individually. Table 8 displays cooperative and competitive choices as a function of interaction partner and facial expression. Because each participant only interacted with each facial expression of each partner once, there was a restricted range in terms of cooperate rates at the required level of analysis, and therefore a lack of normality in regard to the distribution of this variable. Hence, for these analyses, the data were left in their raw form (i.e. compete or cooperate) and analysed categorically. Chi-squared tests for independence were performed to compare the number of cooperative and competitive choices as a function of posed and genuine smiles for each interaction partner separately. Neutral expressions were not included

Table 8: Summary of participant responses (cooperated or competed) by interaction partner and facial expression for Experiment 3.

Facial expression	Participant response: Cooperated	Competed	Coop. %
Partner 1			
Neutral expression	16	13	55.2%
Posed smile (open mouth)	16	13	55.2%
Genuine smile (open mouth)	19	10	65.5%
Partner 2			
Neutral expression	19	10	65.5%
Posed smile (closed mouth)	13	16	44.8%
Genuine smile (closed mouth)	19	10	65.5%
Partner 3			
Neutral expression	19	10	65.5%
Posed smile (closed mouth)	15	14	48.3%
Posed smile (open mouth)	15	14	51.7%

in the present analysis as the focus of this study is on the differences in cooperative behaviour as a function of posed and genuine smiles. Partner 1 (open mouth posed and genuine smiles) was cooperated with on 55% of interactions when she was exhibiting a posed smile, and on 66% of interactions when she was exhibiting a genuine smile, $\chi^2 = (1,29) = 0.65$, $p = 0.42$. Partner 2 (closed mouth posed and genuine smiles) was cooperated with on 45% of interactions when she was exhibiting a posed smile, and on 66% of interactions when she was exhibiting a genuine smile, $\chi^2 = (1,29) = 2.51, p = 0.11$. Partner 3 (closed and open mouth posed smiles) was cooperated with on 48% of interactions when she was exhibiting a closed mouth posed smile, and on 52% of interactions when she was exhibiting a open mouth posed smile, $\chi^2 = (1,29) = 0.07, p = 0.79$. Although these analyses did not reveal significant effects, a clear trend exists consistent with the previous findings in that cooperation was more frequent when interacting with a partner exhibiting a genuine smile compared with a posed smile. Furthermore, although no definitive conclusions can be drawn here, there is some indication of a slight trend toward cooperation being more likely when interacting with an individual exhibiting an open mouth posed smile compared to a closed mouth posed smile. This result is consistent with the effects reported for Experiments 1a and 1b whereby smiles with the teeth exposed (i.e. open mouth smiles) were more likely to be categorised as an expression of happiness than were smiles without the teeth exposed regardless of veracity.

Social value orientation.

In total, in regard to social value orientation 16 participants were classified as cooperative, 7 participants were classified as individualists, 1 was classified as a competitor, and 5 could not be classified (i.e. did not make 6 consistent choices out of the 9 decomposed games). Hence, in order to retain sufficient statistical power to perform the required analyses, participants' social value orientation was reclassified to a binary category of prosocial[90] or non-prosocial.[91] This classification is reasonable when considered in the context of the operational definitions of the categories of

[90] Cooperators will be referred to as prosocials in these analyses to aid clarity.

[91] Thus, the non-prosocial category included all participants classified as individualists and competitors as well as those participants who could not be classified.

social value orientation, that is, the present reclassification can be interpreted to represent a distinction between participants who attempt to maximise gain for their interaction partner (i.e. prosocial) and those who do not adopt this strategy. Overall, there were 16 prosocial participants and 13 non-prosocial in the present sample.

An independent means t-test was conducted to compare overall cooperation rates between the prosocial and non-prosocial groups. A comparison of mean cooperation rates revealed that the prosocial participants ($M_{prosocial} = 0.70$) exhibited a significantly higher rate of cooperation than did the non-prosocial participants ($M_{non\text{-}prosocial} = 0.44$), $t(26) = 3.31$, $p < 0.01$, a result which is consistent with previous research (e.g. Kuhlman & Marshello, 1975; McClintock & Liebrand, 1988; Sally, 2000; Van Lange et al., 1992).

Resource dilemma.

The relationship between the amount of resources harvested during the resource dilemma task and cooperation rates during the Prisoners' Dilemma task was examined using a series of Pearson product-moment correlations. Specifically, the number of fish harvested in each season, as well as the total number of fish harvested were correlated with the cooperation rates for interactions with partners exhibiting neutral expressions, posed smiles and genuine smiles respectively, as well as with the overall rate of cooperation. No significant correlations were revealed. There appeared to be no relationship between the amount of resource harvested in the resource dilemma task and cooperation during the Prisoners' Dilemma task.

Participant mood.

The relationship between participants' self-reported mood and their cooperative behaviour in the Prisoners' Dilemma task was also examined using a series of Pearson product-moment correlations. Specifically, mood scores from all five mood measures were correlated with the cooperation rates for interactions with partners exhibiting neutral expressions, posed smiles, and genuine smiles respectively, as well as with the overall rate of cooperation. Only one significant correlation was revealed between the initial mood score (i.e. the mood rating made prior to the first interaction task) and the cooperation rate for interactions with a partner exhibiting a neutral expression, r (29) = 0.42, $p < 0.05$. The more positive a participant rated their mood, the more likely they were to cooperate on their first set of interactions, that is, when interacting with a partner exhibiting a neutral expression.

Participant facial expression.

Throughout the Prisoners' Dilemma procedure, the facial expressions of each participant were recorded to digital video. Each clip was examined for the presence of smiling, and any smiles subsequently coded as posed or genuine (see Chapter 3 for coding details). Coding of smiles was not possible at all for one participant as her hairstyle and glasses obscured the area of her face where *orbicularis oculi* contraction can been observed (i.e. the temples and outer corners of the eyes). In total, participants exhibited 207 posed smiles and 91 genuine smiles. The relationship between the total number of posed and genuine smiles exhibited by each participant and cooperative behaviour was assessed using a series of Pearson product-moment correlations. Specifically, the respective number of posed and genuine smiles expressed by participants during the Prisoners' Dilemma task were correlated with the cooperation rates for interactions with partners exhibiting neutral expressions, posed smiles, and genuine smiles respectively, as well as with the overall rate of cooperation. A significant positive relationship was revealed between the total number of genuine smiles the participant expressed and the cooperation rate for interactions with a genuinely smiling partner, $r(28) = 0.38, p < 0.05$. When their interaction partner was exhibiting a genuine smile, cooperation was positively related to the total number of genuine smiles exhibited by each participant. No other significant relationships were revealed.

Order of interaction.

To investigate the possibility that cooperative behaviour systematically varied over the course of the Prisoners' Dilemma procedure, responses to the first and second smile interactions with each partner were compared. Neutral expressions were not included in the present analysis as there was a break in the procedure between the neutral expression trials and the smile trials, hence it is not clear whether responses are directly comparable between these trials in regard to the order of interactions. Table 9 displays cooperative and competitive choices as a function of interaction partner and interaction order.

Chi-squared tests for independence were performed to compare the number of cooperative and competitive choices as a function of interaction order for each interaction partner separately. These results revealed a consistent trend across all interaction partners whereby cooperation was more frequent for the first smile interaction than the second. Specifically, when interacting with Partner 1 (open mouth posed and genuine smiles), 69% of participants cooperated on the first interaction,

Table 9: Summary of participant responses (competed or cooperated) by interaction partner and interaction order for 'smile' interactions for Experiment 3.

Interaction order	Participant response Cooperated	Competed	Coop. %
Partner 1			
Interaction 1	20	9	69.0%
Interaction 2	19	10	51.7%
Partner 2			
Interaction 1	18	11	62.1%
Interaction 2	14	15	48.3%
Partner 3			
Interaction 1	15	14	58.6%
Interaction 2	15	14	41.4%

while 52% cooperated on the second interaction (χ^2 = (1,29) = 1.8, p = 0.18). For interactions with Partner 2 (closed mouth posed and genuine smiles), 62% of participants cooperated on the first interaction, while 47% cooperated on the second interaction (χ^2 = (1,29) = 1.12, p = 0.29). Finally, when interacting with Partner 3 (closed and open mouth posed smiles), 59% of participants cooperated on the first interaction, while 41% cooperated on the second interaction. Although this effect did not reach statistical significance for any of the interaction partners, there appears to be a clear trend across all interaction partners whereby cooperation was more likely on the initial interaction with each partner when they were smiling.

To this point a number of influences on cooperative behaviour in the Prisoners' Dilemma task of the present study have been identified. Specifically, the facial expressions of the respective interaction partners, as well as the social value orientation of the participant have been shown to influence cooperation. Furthermore, the self-reported mood of the participant, the facial expressions of the participant, and the order of interactions have also been shown to be related to cooperative behaviour, although the statistical evidence here is less compelling. However, the effects of these factors have, so far, only been considered in a univariate manner. To further understand the influence of these factors on cooperative behaviour in the present study, it is necessary to take a multivariate approach to the present analysis by considering the factors identified as influencing cooperation rates above in combination. This will allow a determination of the relative impact of each of these factors on cooperation rates in the present experiment. To this end a logistic regression analysis was used to model the present data. Specifically, the relevant factors from the above analysis were used to predict the likelihood of cooperation for each interaction. This allows for the contribution of each factor to be considered in a multivariate manner whereby the influence of one factor can be assessed while simultaneously controlling for all other factors. Importantly, this provides the ability to assess the influence of the facial expression displayed in each interaction on the likelihood to cooperate, while keeping the influence of all other relevant factors constant (i.e. to assess the impact of facial expressions on cooperation over and above that of the other factors measured). This approach also provides the advantage of being able to use participant responses in their raw binary form (i.e. compete or cooperate) as the dependent variable, and thereby avoids the need to collate or collapse across interaction partners or across responses. Furthermore, this allows for each interaction with each partner to be modelled separately thereby preserving the structure of the procedure within the structure of the analysis. In other words, the effects of those factors shown to influence cooperation can be investigated in regard to each individual interaction.

A summary of the relevant factors included in this analysis is displayed in Table 10. To maximise the available statistical power for the present analysis, all variables were coded into binary categories. As such, the facial expressions of interaction Partners 1 and 2 were coded to reflect whether or not the partner was exhibiting a genuine smile (i.e. GENSMILE). The facial expression of interaction Partner 3 (who only exhibited posed smiles) was coded to reflect whether or not she was exhibiting an open mouth posed smile (i.e. OPENPOSED). Participants' social value orientation as assessed using the decomposed games task (see above) was coded to reflect whether or not they were classified as prosocial (i.e. PROSOCIAL). Participants' facial expressions were coded to reflect whether or not they exhibited a genuine smile during the interaction being modelled (i.e. PPTGENSM).

Table 10: Independent Variables for Logistic Regression Analysis, Experiment 3.

Variable	*Description*
GENSMILE*	facial expression of interaction partner was genuine smile (reference condition = posed).
OPENPOSED**	Facial expression of interaction partner was open mouth posed smile (reference condition = closed mouth posed smile).
PROSOCIAL	participant had a 'prosocial' Social Value Orientation (reference condition = pro-self).
PPTGENSM	participant genuinely smiled during interaction (reference condition = no genuine smile).
COOPNEUT	participant cooperated during the neutral interaction with this partner (reference condition = competed neutral interaction).
COOPINT1	participant cooperated during the first interaction with this partner (reference condition = competed first interaction).

Note: All variables were coded to predict the likelihood of making a *cooperative* choice for the interaction being modelled.
* = Interaction Partners 1 and 2 only. ** = Interaction Partner 3 only.

Interaction order was also considered in the present analysis by modelling each interaction separately, however this still leaves open the possibility that participants simply cooperated with one partner more than the others. To take account of the history with any given interaction partner, responses to the neutral expression interaction with the same participant as for the interaction being modelled were coded to reflect whether the participant cooperated or not (i.e. COOPNEUT), as were responses to the first interaction with that participant (i.e. COOPINT1). The mood of participants was not included in the present analysis as it was shown to only have relevance for cooperation with an interaction partner exhibiting a neutral expression, while the focus here is on cooperative behaviour as a function of posed and genuine smiles. The dependent variable (whether the participant cooperated or competed on the interaction being modelled) was coded such that the independent variables were predicting the likelihood that the participant's response was cooperative.

It is acknowledged that the sample size of the present study is a limiting factor with regard to the statistical significance of any effects revealed. However, it is suggested that even in these circumstances, a multivariate approach to the present data provides value in that the general trends in any relationship revealed between smile veracity and cooperation can be examined while controlling for other relevant factors. Hence, the logistic regression analysis was performed by fitting the data to a binary logit model using the PROC LOGISTIC procedure in the SAS statistical software package. Each smiling interaction with each partner was modelled separately. Initially, each factor was entered into the model in a univariate manner, before all factors were entered simultaneously into a multivariate model. As the present analysis is primarily intended to assess the influence of smile veracity on cooperative behaviour in the

Prisoners' Dilemma task while controlling for other relevant factors, particular emphasis is given to the odds ratios reported. In regard to the present analysis, the reported odds ratios (OR) can be interpreted to reflect the likelihood of cooperation, given the factor of interest. For example, if the variable GENSMILE has an OR of 2.00, this suggests that cooperation is twice as likely when the interaction partner was genuinely smiling compared to when they were exhibiting a posed smile. The results are presented below for each interaction partner separately. Consistent with the aims of this study, the emphasis within the interpretation of these results is on the influence of the facial expression of the interaction partners on the likelihood of participants to cooperate. To this end, an approximate guideline for assessing such effects in the present research is to consider odds ratios greater than 2 (a doubling in the likelihood of cooperation) to be indicative of a general trend. However, consideration here should also be given to the associated probability levels (p-values) as estimates of the general statistical significance of any variables shown to influence cooperation according to the general conventions (i.e. $p < 0.05$ is considered statistically significant).

Partner 1.

Table 11 displays the frequency of cooperative and competitive choices for interactions with Partner 1 (open mouth posed and genuine smiles) for each of the independent variables included in the logistic regression analysis. With regard to the variable PPTGENSM (i.e. whether the participant exhibited a genuine smile during the course of the interaction), the expressions of two participants were not able to be coded for either interaction (one because her glasses and hair obscured her face and the other because she moved out of the camera shot during the procedure), and an additional participant's expressions could not be coded for the second interaction (because her hair obscured her face for this interaction only). A visual inspection of the percentage of cooperative choices associated with each variable provides an initial confirmation of the trend observed in the analysis presented above in that the partner's facial expression appears to be influencing cooperation, especially during

Table 11: Summary of participant responses (competed or cooperated) for interactions with Partner 1 (open mouth posed and genuine smiles) during the Prisoners' Dilemma task for each predictor variable in the logistic regression analysis, Experiment 3.

		Participant response		
Variable		Cooperated	Competed	Coop %
Interaction 1				
GENSMILE	Genuine smile	11	3	78.6%
	Posed smile	9	6	60.0%
PROSOCIAL	Prosocial	11	4	73.3%
	Pro-self	9	5	65.3%
PPTGENSM	Genuine smile	11	5	59.3%
	No genuine smile	7	4	40.7%
COOPNEUT	Coop(neutral int.)	11	5	68.8%
	Comp(neutral int.)	9	4	69.2%
Interaction 2				
GENSMILE	Genuine smile	8	7	53.3%
	Posed smile	7	7	50.0%
PROSOCIAL	Prosocial	12	3	80.0%
	Pro-self	3	11	21.4%
PPTGENSM	Genuine smile	6	6	50.0%
	No genuine smile	8	6	57.1%
COOPNEUT	Coop(neutral int.)	10	6	62.5%
	Comp(neutral int.)	5	8	38.5%
COOPINT1	Coop(1st int.)	11	9	55.0%
	Comp(1st int.)	4	5	44.4%

the first interaction with this participant. Social value orientation also appears to have a strong effect on cooperation, particularly for the second interaction.

All variables were initially entered individually into a logistic regression to estimate the extent of the relationship between that variable and cooperation. Subsequently all variables were entered into the same model simultaneously. The results from both the univariate and multivariate models are displayed in Table 12. Although no variables predicted cooperation to a statistically significant degree, it can be seen that during their first interaction, participants were approximately 2.5 times more likely to cooperate with Partner 1 if she was expressing a genuine smile compared to a posed smile. This result obtained when smile type was considered as a single predictor variable, as well as when the influence of the other predictors were controlled for. However, for the second interaction with Partner 1, smile veracity appeared to be unrelated to cooperation. For this interaction, the social value orientation of participants predicted cooperation to a statistically significant extent ($p < 0.01$). Prosocial participants were, all else being equal, approximately 18 times more likely to cooperate on their second interaction with Partner 1 than were non-prosocial participants. There was also an indication of a trend toward those participants who cooperated with Partner 1 when she was exhibiting a neutral expression, also cooperating with her during their second smile interaction.

Table 12: Summary of logistic regression analysis for variables predicting cooperation for interactions with Partner 1 (open mouth posed and genuine smiles) by interaction order, Experiment 3.

Variable	Std Est.(*error*)	χ^2	*p*	OR (95% CI)
Interaction 1				
Univariate models				
GENSMILE	***0.89* (0.84)**	***1.13***	***0.29***	***2.44 (0.47-12.63)***
PROSOCIAL	0.42 (*0.81*)	0.28	0.60	1.53 (0.31-7.44)
PPTGENSM	0.23 (*0.83*)	0.08	0.78	1.26 (0.25-6.38)
COOPNEUT	-0.02 (*0.81*)	0.01	0.98	0.98 (0.20-4.76)
Multivariate model				
GENSMILE	**0.96 (*0.91*)**	**1.09**	**0.30**	**2.60 (0.43-15.61)**
PROSOCIAL	0.64 (*0.93*)	0.48	0.49	1.90 (0.31-11.84)
PPTGENSM	0.14 (*0.97*)	0.02	0.88	1.15 (0.17-7.75)
COOPNEUT	-0.08 (*0.86*)	0.01	0.93	0.92 (0.17-5.03)
Interaction 2				
Univariate models				
GENSMILE	***0.13* (0.74)**	***0.03***	***0.86***	***1.14 (0.27-4.91)***
PROSOCIAL	2.69 (*0.92*)	8.58	<0.01	14.66 (2.43-88.49)
PPTGENSM	-0.29 (*0.79*)	0.13	0.72	0.75 (0.16-3.53)
COOPNEUT	0.98 (*0.77*)	1.63	0.20	2.67 (0.59-12.04)
COOPINT1	0.42 (*0.81*)	0.28	0.60	1.53 (0.31-7.44)
Multivariate model				
GENSMILE	**-0.24(*1.06*)**	**0.05**	**0.82**	**0.79 (0.10-6.33)**
PROSOCIAL	2.92 (*1.08*)	7.30	<0.01	18.61 (2.32-155.1)
PPTGENSM	0.28 (*1.06*)	0.07	0.79	1.33 (0.17-10.69)
COOPNEUT	0.93 (*1.06*)	0.77	0.38	2.52 (0.32-20.05)
COOPINT1	0.80 (*1.15*)	1.15	0.49	2.22 (0.24-21.03)

Partner 2.

The frequencies of competitive and cooperative choices for interactions with Partner 2 (closed mouth posed and genuine smiles) are displayed in Table 13. As for Partner 1, no data regarding participants' facial expressions were included for two participants for the first interaction, and for three participants for the second interaction with

Partner 2 (see above for details). An inspection of the percentage of cooperative choice displayed in Table 13 indicates that smile veracity influenced cooperation for both interactions, but more so for interaction 2.

Table 13: Summary of participant responses (competed or cooperated) for interactions with Partner 2 (closed mouth posed and genuine smiles) during the Prisoners' Dilemma task for each predictor variable in the logistic regression analysis, Experiment 3.

		Participant response		
Variable		Cooperated	Competed	Coop rate
Interaction 1				
GENSMILE	Genuine smile	12	6	66.7%
	Posed smile	6	5	54.6%
PROSOCIAL	Prosocial	12	3	80.0%
	Pro-self	6	8	42.9%
PPTGENSM	Genuine smile	12	5	70.6%
	No genuine smile	5	5	50.0%
COOPNEUT	Coop(neutral int.)	15	4	79.0%
	Comp(neutral int.)	3	7	30.0%
Interaction 2				
GENSMILE	Genuine smile	7	4	63.6%
	Posed smile	7	11	38.9%
PROSOCIAL	Prosocial	9	6	60.0%
	Pro-self	5	9	35.7%
PPTGENSM	Genuine smile	4	6	40.0%
	No genuine smile	8	8	50.0%
COOPNEUT	Coop(neutral int.)	7	12	36.8%
	Comp(neutral int.)	7	3	70.0%
COOPINT1	Coop(1st int.)	9	9	50.0%
	Comp(1st int.)	5	6	45.5%

Furthermore, the social value orientation of participants appears to have influenced cooperation for both interactions, while both the facial expression of the participant, and their choice to compete or cooperate during the neutral interaction with this partner seemed to influence cooperation, although in different directions for each interaction.

All variables were initially entered individually into a logistic regression to estimate the extent of the relationship between that variable and cooperation. Subsequently all variables were entered into the same model simultaneously. The results from both the univariate and multivariate models are displayed in Table 14. For the first interaction with Partner 2, smile veracity did not appear to influence cooperation (although the direction of the effect was consistent with that hypothesised). However, for this interaction, both social value orientation and the participant's response when interacting with Partner 2 exhibiting a neutral expression were related to cooperation. Specifically, when all other variables were controlled, prosocial participants were approximately 7.7 times more likely to cooperate on their first interaction with Partner 2 than were non-prosocial participants. Furthermore, those participants who cooperated with Partner 2 on the neutral expression interaction were approximately 18 times more likely to cooperate on their first interaction with Partner 2 than those who competed during the neutral interaction trial. This effect was statistically significant ($p < 0.05$).

For the second interaction with Partner 2 however, smile veracity did appear to influence cooperation. After controlling for all other factors, for their second interaction with Partner 2, participants were shown to be approximately 3.6 times more likely to cooperate if she was expressing a genuine smile compared to a posed smile. Also relevant to this interaction was the participant's response to their interaction with Partner 2 when she was exhibiting a neutral expression. However, contrary to the previous interaction, participants who had cooperated with Partner 2 when she displayed a neutral expression were approximately 6 times *less* likely to cooperate than those who had competed during the neutral interaction trial.

Table 14: Summary of logistic regression analysis for variables predicting cooperation for interactions with Partner 2 (closed mouth posed and genuine smiles) by interaction order.

Variable	Std Est.(*error*)	χ^2	*p*	OR (95% CI)
Interaction 1				
Univariate models				
GENSMILE	***0.51 (0.79)***	***0.42***	***0.51***	***1.67 (0.36-7.77)***
PROSOCIAL	1.67 (*0.84*)	3.96	0.05	5.33 (1.03-27.76)
PPTGENSM	0.88 (*0.83*)	1.12	0.29	2.40 (0.48-12.13)
COOPNEUT	2.17 (*0.89*)	5.93	0.01	8.75 (1.53-50.11)
Multivariate model				
GENSMILE	**0.41 (*1.04*)**	**0.16**	**0.70**	**1.50 (0.20-11.44)**
PROSOCIAL	2.04 (*1.24*)	2.70	0.10	7.71 (0.68-87.90)
PPTGENSM	-0.02 (*1.09*)	0.01	0.99	0.98 (0.12-8.40)
COOPNEUT	2.90 (*1.26*)	2.70	0.02	18.11 (1.54-213.3)
Interaction 2				
Univariate models				
GENSMILE	***1.01 (0.79)***	***1.63***	***0.20***	***2.75 (0.58-12.98)***
PROSOCIAL	0.99 (*0.77*)	1.68	0.20	2.70 (0.60-12.15)
PPTGENSM	-0.41 (*0.82*)	0.25	0.62	0.67 (0.14-3.30)
COOPNEUT	-1.39 (*0.84*)	2.74	0.10	0.25 (0.48-1.29)
COOPINT1	0.18 (*0.76*)	0.06	0.81	1.20 (0.27-5.40)
Multivariate model				
GENSMILE	**1.23 (*1.03*)**	**1.58**	**0.21**	**3.64 (0.48-27.34)**
PROSOCIAL	0.66 (*1.01*)	0.43	0.51	1.93 (0.27-14.00)
PPTGENSM	-0.83 (*1.01*)	0.68	0.41	0.44 (0.20-3.16)
COOPNEUT	-1.95 (*1.28*)	2.33	0.13	0.14 (0.01-1.74)
COOPINT1	0.99 (*1.32*)	0.56	0.45	2.71 (0.20-36.23)

Partner 3.

Table 15 displays the frequencies of competitive and cooperative responses to interactions with Partner 3 (closed and open mouth posed smiles). No data regarding participants' facial expressions were included for two participants across both the first and second interactions with Partner 3 (see above for details). A visual inspection of

Table 15: Summary of participant responses (competed or cooperated) for interactions with Partner 3 (closed mouth posed smile and open mouth posed smile) during the Prisoners' Dilemma task for each predictor variable in the logistic regression analysis, Experiment 3.

		Participant response		
Variable		Cooperated	Competed	Coop rate
Interaction 1				
OPENPOSED	Open mouth posed	10	5	66.7%
	Closed mouth posed	7	7	50.0%
PROSOCIAL	Prosocial	10	5	66.7%
	Pro-self	7	7	50.0%
PPTGENSM	Genuine smile	7	7	50.0%
	No genuine smile	8	5	61.5%
COOPNEUT	Coop(neutral int.)	14	5	73.7%
	Comp(neutral int.)	3	7	30.0%
Interaction 2				
OPENPOSED	Open mouth posed	5	9	35.7%
	Closed mouth posed	7	8	46.7%
PROSOCIAL	Prosocial	8	7	53.3%
	Pro-self	4	10	28.6%
PPTGENSM	Genuine smile	5	6	45.5%
	No genuine smile	6	10	37.5%
COOPNEUT	Coop(neutral int.)	9	10	47.4%
	Comp(neutral int.)	3	7	30.0%
COOPINT1	Coop(1st int.)	9	8	52.9%
	Comp(1st int.)	3	9	25.0%

the percentage of cooperative choices displayed in Table 15 indicates that cooperation was more frequent when Partner 3 was exhibiting an open mouth posed smile for Interaction 1, but less frequent for Interaction 2. There is also an indication that a prosocial value orientation led to more cooperation, as did cooperating with Partner 3 during the neutral interaction trial, or during Interaction 1.

All variables were initially entered individually into a logistic regression to estimate the extent of the relationship between that variable and cooperation. Subsequently, all variables were entered into the same model simultaneously. The results from both the univariate and multivariate models are displayed in Table 16. For the first interaction, participants were approximately 3.3 times more likely to cooperate if Partner 3 was displaying an open mouth posed smile compared to a closed mouth posed smile, once all other factors were controlled for. Furthermore, those who cooperated with Partner 3 when she displayed a neutral expression were approximately 5.9 times more likely to cooperate on their first interaction with her than those who competed on the neutral interaction trial. With all other factors controlled for, this effect approached statistical significance ($p = 0.07$). There also appears to be a trend toward a negative association between participants' genuine smiles and cooperation. Participants who exhibited one or more genuine smiles during their first interaction with Partner 3 were approximately 3 times less likely to cooperate on this interaction than those who did not display any genuine smiles.

In regard to the second interaction with Partner 3, the type of smile displayed by Partner 3 appeared to influence cooperation, although only when all other factors were controlled for. When smile type was considered as a single predictor of cooperation, there was a very weak trend toward closed mouth posed smiles being cooperated with more frequently than open mouth posed smiles.

Table 16: Summary of logistic regression analysis for variables predicting cooperation with Partner 3 (closed mouth posed smile and open mouth posed smile) by interaction order, Experiment 3.

Variable	Std Est.(*error*)	χ^2	*p*	OR (95% CI)
Interaction 1				
Univariate models				
OPENPOSE	***0.69* (0.76)**	***0.82***	***0.37***	***2.00 (0.45-8.96)***
PROSOCIAL	0.69 (*0.76*)	0.82	0.37	2.00 (0.45-8.96)
PPTGENSM	-0.47 (*0.78*)	0.36	0.55	0.63 (0.14-2.89)
COOPNEUT	1.88 (*0.86*)	4.71	0.03	6.53 (1.20-35.73)
Multivariate model				
OPENPOSE	**1.19 (*1.18*)**	**1.01**	**0.31**	**3.28 (0.32-33.20)**
PROSOCIAL	-0.29 (*1.08*)	0.07	0.79	0.75 (0.09-6.14)
PPTGENSM	-1.18 (*1.09*)	1.16	0.28	0.31 (0.04-2.63)
COOPNEUT	1.78 (0.99)	3.25	0.07	5.93 (0.86-41.16)
Interaction 2				
Univariate models				
OPENPOSE	***-0.45* (0.76)**	***0.36***	***0.55***	***0.64 (0.14-2.82)***
PROSOCIAL	1.05 (*0.79*)	1.78	0.18	2.86 (0.61-13.34)
PPTGENSM	0.33 (*0.80*)	0.17	0.68	1.39 (0.29-6.61)
COOPNEUT	0.74 (*0.83*)	0.80	0.37	2.10 (0.41-10.66)
COOPINT1	1.22 (*0.83*)	2.17	0.14	3.38 (0.67-17.00)
Multivariate model				
OPENPOSE	**0.92 (*1.07*)**	**0.74**	**0.39**	**2.51 (0.31-20.43)**
PROSOCIAL	2.51 (*1.35*)	3.46	0.06	12.34 (0.87-174.5)
PPTGENSM	1.39 (*1.23*)	1.28	0.26	4.03 (0.36-45.07)
COOPNEUT	0.09 (*1.09*)	0.01	0.94	1.09 (0.13-9.31)
COOPINT1	1.02 (*1.01*)	1.02	0.31	2.77 (0.39-19.94)

However, in the multivariate model, the direction of this effect was reversed. When all other predictors were controlled for, participants were approximately 2.5 times more likely to cooperate when Partner 3 was exhibiting an open mouth posed smile than when she was exhibiting a closed mouth posed smile, although this effect remained weak. The social value orientation of participants was also relevant to cooperation for this interaction in that prosocial participants were approximately 12.3 times more likely to cooperate than pro-self participants. This effect approached statistical significance ($p = 0.06$). Furthermore, participants who exhibited one or more genuine smiles during their second interaction with Partner 3 were approximately 4 times more likely to cooperate during this interaction than those who displayed no genuine smiles. Finally, those who cooperated with Partner 3 during their previous interaction were approximately 2.8 times more likely cooperate on Interaction 2 than those who had previously competed.

Discussion

Overall, the results from Experiment 3 clearly indicate that, as predicted, cooperative behaviour in the context of the Prisoners' Dilemma game was influenced by the facial expression of the interaction partner. Specifically, participants showed a greater proclivity to cooperate with a partner exhibiting a genuine smile than with a partner exhibiting a posed smile. Furthermore, posed smiles with features that have been previously shown to be associated with these expressions being misperceived as genuine smiles (i.e. open mouth posed smiles that expose the teeth, see Experiments 1a and 1b) appeared to attract more cooperative behaviour than posed smiles without this feature. In addition, the relationship revealed between genuine smiles exhibited by the participants and cooperation with genuinely smiling partners is also consistent with the prediction that genuine smiles specify a willingness to cooperate. Together, these findings provide support for the hypothesised relationship between smile veracity and cooperation. Consistent with Owren and Bachorowski's (2001) account of the function of smiling in social interactions, it appears as though genuine smiles facilitate cooperation when they are perceived and expressed.

An interesting finding to emerge from this experiment is that cooperation rates did not appear to differ between interactions with a partner exhibiting a neutral expression or in interactions with a partner exhibiting a genuine smile. Initially, this may be taken as evidence contrary to the hypothesised function of genuine smiles in social interaction. To this end, it may be that an inhibitory effect of posed smiles rather than a facilitory effect of genuine smiles on cooperative behaviour, accounts for the current findings. It can be speculated that posed smiles specify information that encourages competitive behaviour rather than genuine smiles specifying opportunities to cooperate. Given that posed smiles are believed to specify motives or intentions rather than opportunities related to emotional experience, it could be that in the context of a social dilemma the affordances specified by any given posed smile lack direct relevance, when compared with genuine smiles, to the situation at hand. In this case, participants may be more inclined to compete with partners exhibiting posed smiles in that this may well be the more rational behaviour given the lack of relevant, emotion specific information regarding the partner's likely behaviour in a dilemma situation. Alternatively, the lack of significant differences in the cooperation rates for interactions with neutral and genuinely smiling partners may be the result of the design of the current experiment. Consistent with the present data, previous literature regarding the effects on cooperative behaviour of multiple trials of social dilemma type interactions has reported that typically, cooperation rates are highest during the initial interaction and decline on subsequent interactions (Komorita & Parks, 1995; Parks, Sanna, & Berel, 2001; Van Lange et al., 1992). The design for Experiment 3 required that all participants interact with all partners exhibiting a neutral expression before any interactions with a smiling partner took place. Thus, it is not possible to confirm from the present research whether the cooperation rate for interactions with partners exhibiting a neutral expression was elevated as a function of these interactions always taking place before any of the smiling interactions, or alternatively, that posed smiles led to an increase in competitive behaviour rather than genuine smiles facilitating cooperation. Although this issue awaits further research, the previous literature relevant to these effects indicates that the former explanation regarding the order of interactions is probably more likely if it is assumed that behaviour of participants in the present dilemma situation is generally consistent with that reported for other similar studies.

The results from the multivariate models, although somewhat limited by the sample size of the present study, also lend support to the prediction that genuine smiles specify an opportunity to cooperate. During both the first interaction with Partner 1 and the second interaction with Partner 2, participants made more cooperative choices when their partner was exhibiting a genuine smile as compared to a posed smile. Importantly, for both interaction partners, this trend remained when all other relevant factors were controlled for. Furthermore, the results from interactions with Partner 3 also suggest that participants were more likely to cooperate when their partner was exhibiting a posed smile with the teeth exposed than a posed smile without exposing the teeth. Although this may be taken as evidence against the current hypothesis that only genuine smiles specify cooperability, it should be noted that overall, cooperation rates for interactions with this partner were lower than for either of the other two partners (i.e. P1 = 60.3%, P2 = 55.2%, P3 = 50%). Therefore, a more likely explanation is that the perceptual bias associated with smiles that expose the teeth resulted in the posed smiles of Partner 3 with this feature being misperceived by some participants as genuine smiles and, therefore, attracted more cooperative behaviour, consistent with the findings reported for Experiments 1a and 1b (see Chapter 4).

A somewhat puzzling aspect of these results concerns the different effects of interaction order between interaction partners. Although there is no evidence to directly indicate why the effect of smile veracity was only influential for the first interaction with Partner 1, but was not observed until the second interaction with Partner 2, it is suggested that this may have resulted in part as an artefact of the procedure employed, and in part as a function of the differences between the two sets of smiles. The characteristics of Partner 1's smiles (i.e. open mouth with teeth exposed) have been found to result in readily identifiable genuine smiles, but also posed smiles that are commonly misperceived as genuine smiles (see Experiments 1a and 1b), leading to the expectation that cooperation rates for interactions with this partner would be higher than for the other interaction partners. The present data do indeed reflect this; for their first interaction with Partner 1, participants cooperated on 79% of trials when she was genuinely smiling and 60% of trials when she was posing a smile, with both of these rates exceeding those found when all interactions with all partners were considered (i.e. 66% cooperation for genuine smiles, and 50% cooperation for posed smiles). However, when it came to the second interaction with Partner 1, the overall cooperation rates were substantially lower (53% for genuine smile interactions, 50% for posed smile interactions).

It is hypothesised that those participants who, in their initial interaction with Partner 1 cooperated when she was exhibiting a posed smile, did so as a result of misperceiving this expression as a genuine smile. If this is the case, then perhaps upon viewing Partner 1's genuine smile during interaction 2, the previous misperception leads some participants to, in effect, be viewing a second genuine smile. In fact, the cooperation rates for these participants (i.e. those who viewed Partner 1's posed smile in their first interaction and therefore viewed her genuine smile in their second interaction) were very similar between interactions (i.e. 60% cooperation for interaction 1 and 53% cooperation for interaction 2, in terms of the raw data 9 of 15 participants cooperated on interaction 1, and 8 of 15 participants cooperated on interaction 2). On the other hand, those participants who initially interacted with Partner 1 when she was exhibiting a genuine smile were already familiar with this expression when they encountered her posed smile. It is suggested that such familiarity provided these participants with a standard for comparison with regard to the veracity of Partner 1's posed smile, and were therefore better informed regarding the physiognomy of Partner 1's smiles when it came to this interaction. Indeed, those participants who initially interacted with Partner 1 when she was exhibiting a genuine smile showed substantially different rates of cooperation between their first (79%) and second interactions (50%) with this partner. Thus, it is suggested that the characteristics of Partner 1's smiles, in combination with the order of interactions (i.e. posed or genuine first) resulted in differences in the accuracy of the detection of smile veracity and, in turn, produced different influences of this variable on cooperation depending on the interaction in question.

In contrast, for Partner 2, smile veracity was influential with regard to predicting cooperation during the second interaction, but not the first. However, a similar explanation can also be proposed to account for this finding. Again, those participants whose first interaction with Partner 2 was when she was exhibiting a genuine smile were able to subsequently judge the veracity of her second smile with some form of standard for comparison (i.e. her genuine smile). These participants cooperated for 67% of their first trials with Partner 2 (i.e. when she was exhibiting a genuine smile), but only 39% of their second trials with her (i.e. when she was exhibiting a posed smile). This strong tendency to compete with Partner 2 when she was expressing a posed smile was not observed for those participants whose posed smile interaction was their first with Partner 2 (i.e. these participants cooperated on 55% of their posed smile trials with Partner 2). Again, therefore, it is suggested that prior exposure to a genuine smile facilitated accuracy in detecting a posed smile. Furthermore, the characteristics of Partner 2's smiles (i.e. closed mouth smiles with no teeth exposed) meant that, unlike interactions with Partner 1, participants were less likely to misperceive a posed smile as a genuine smile when interacting with Partner 2. As a result, those participants who viewed Partner 2's posed smile first, were less likely to misperceive this expression as a genuine smile and therefore more likely to subsequently perceive Partner 2's genuine smile as an expression distinct from the previous one. Hence, again the characteristics of the interaction partner's smiles, in combination with interaction order, differentially influenced cooperation as a function of smile veracity and interaction number (i.e. first or second).

The present findings are also consistent with the relevant previous literature reviewed. As mentioned above, the overall rate of cooperation (57%) for the Prisoners'

Dilemma task was consistent with that expected for the payoff matrix employed (see Figure 4 and Appendix M) and the fact that participants were interacting in a face-to-face manner with their partners (Sally, 1995). Furthermore, factors previously shown to influence cooperation in Prisoners' Dilemma settings, in particular the social value orientation of participants, were also shown here to have a systematic influence on cooperative behaviour. Importantly, the present results are also, in part, consistent with the earlier research reported by Scharlemann et al. (2001), as well as those reported by Brown and Moore (2002) concerning smiling and cooperation. One difference in the pattern of results revealed in the present study compared to those reported by Scharlemann et al. is the fact that in this research not all smiles facilitated cooperation.[92] As described above, it is possible that the fact that all participants interacted with their partners exhibiting neutral expressions first, influenced cooperation rates for these interactions. Alternatively, it could be argued that in the present study posed smiles inhibited cooperative behaviour. Regardless of these considerations, the present research provides an extension to the findings of Scharlemann et al. in that the nature of the smile employed as a representation of the interaction partner was shown to influence cooperation in the Prisoners' Dilemma situation. The present results are also consistent with those reported by Brown and Moore, in that greater cooperation was observed for interactions with a partner represented as exhibiting a genuine smile compared to interactions with a partner posing a smile. Thus, the present study provides advancement on both of these earlier studies, particularly with respect to the use of ecologically valid facial displays and the realistic simulation of actual face-to-face interactions.

[92] Although this issue is confounded somewhat by the fact that Scharlemann et al. did not report the veracity of the smiles they employed.

Thus, there is evidence from both the initial analyses when the overall cooperation rates across all interactions were considered, and the separate multivariate modelling of each interaction with each partner, to indicate that smile veracity influenced cooperation in a Prisoners' Dilemma situation. However, before these results can be evaluated with regard to the theoretical accounts of the function of posed and genuine smiles in social interaction surveyed above, a number of potential limitations of the present experiment need to be examined. Although there was sufficient statistical power to reveal significant differences in cooperation rates between interactions with posed and genuine smiling partners when all interactions were considered together, the sample size of the present study was a limiting factor for the multivariate analysis. While clear trends in relation to smile type and veracity were shown in this analysis, when these effects were evident they did not reach statistical significance. This should not necessarily be taken as an indication that the results of the logistic regression analyses lacked validity, as factors previously shown to have a strong relationship to cooperation (i.e. Social Value Orientation) did indeed predict cooperative choices at statistically significant levels. Instead, it is likely that within the complexity of the face-to-face Prisoners' Dilemma interaction, the size of the effects of smile veracity on cooperation were not as large as those produced by other factors. Hence, it is argued here that the trends revealed in the multivariate analysis relevant to the relationship between smile veracity and cooperation do indeed accurately reflect this relationship within the present data.

Furthermore, some authors have questioned the external validity of experimental games such as the Prisoners' Dilemma. For instance, Nemeth (1972) objected to the lack of mundane realism in laboratory-based social dilemma situations on the basis that these procedures are often only minimally social and do not reflect the richness of real-world social interaction. In addition, Kollock (1998), in a substantial review of the social dilemma literature, criticised the conduct of many such experimental games in research settings on the basis that participants were not motivated by incentives equivalent to those which may be available in social dilemmas outside the laboratory. For instance, in this regard Kollock commented that "it is entirely possible that many of the inconclusive or contradictory results that are reported in the literature are due in part to subjects being faced with outcomes that are trivial" (p. 207).

Both of these criticisms are rejected in relation to the present study. Firstly, many of the aspects of an actual interaction were present in the procedure employed. In particular, the apparently face-to-face interaction between the participant and her interaction partner represents a level of ecological validity only rarely found in social dilemma research. With the exception of research that directly examined the effects of communication in social dilemma settings (e.g. see Sally, 1995; 2000), the majority of research in this area required participants to interact with direct social contact. Admittedly, the interactions in the present research were not actual social interactions, but it can be inferred from the fact that no participant reported any suspicion that their interaction partner was not actually present that the situation was perceived as real. Indeed, a number of participants even attempted to communicate with their partners by waving or saying hello, and many blushed during the phases of the procedure when they thought the partner could see them. Secondly, before the beginning of each task participants were reminded verbally and in written instructions that the more points or resources that they accumulated during the interaction tasks, the more they would be paid at the end of the experiment. Thus, all participants were under the illusion that they could earn up to $25 for their participation, but if they performed poorly, they would only earn $5. Although these amounts are by no means large, it is suggested that the difference between the maximum and minimum potential earnings was sufficient to motivate participants, who were all university students, to behave in ways that secured themselves the largest possible amount, or at least as they would in a similar situation outside of the laboratory, where payoffs are also non-trivial. Hence, the level of mundane realism in the present study was sufficient to generalise, with some confidence, from the experimental setting to an actual interaction. The use of ecologically valid facial displays, sufficient incentive to motivate participants to take the task seriously, and an elaborate procedure to ensure participants believed they were actually interacting with other participants, together provide grounds for the generalisation of these results to situations outside the laboratory setting.

In a more general sense, the results of the present research can be taken as preliminary support for Owren and Bachorowski's (2001) recent evolutionary theory regarding the function of smiling during social exchange. In particular, the significant difference in cooperation rates between posed and genuine smile interactions offers direct support for the proposition that the detection of a genuine smile provides the individual with information specifying an opportunity for cooperative behaviour, inasmuch as a positive emotional state relates to a commitment to cooperate. In addition, the observed trend whereby posed smiles with features that have previously been associated with these expressions are misperceived as genuine smiles (i.e. open mouth with teeth exposed), also attracted higher rates of cooperation than posed smiles without this feature, is also consistent with the claim that genuine smiling facilitates cooperation. However, the evidence is less clear when it comes to the role of the facial expressions of the participants in predicting cooperative behaviour. Although there was a relationship between the number of genuine smiles displayed by participants and cooperation with genuinely smiling partners, the results of the multivariate modelling did not reflect this trend. It may be the case, however, that the somewhat disjointed nature of the interactions, in particular the fact that participants did not believe their partner could see them when they could see their partner, and the delay between transmissions to and from the participant, may have interrupted the spontaneous feed-back loop between the detection of a genuine smile and the elicitation of positive emotion and further genuine smiling as proposed by Owren and Bachorowski. There is no scope within the present methodology to test this notion further; hence additional research is required to understand more precisely the relationship between the exhibition of a genuine smile and the propensity to cooperate. However, the overall relationship between participant genuine smiles and cooperation revealed in the present research is still consistent with the claim that genuine smiles foster positive emotion and reciprocal cooperation between interaction partners. Indeed, the fact that participants' genuine smiles did not relate to cooperation when interacting with partners exhibiting either neutral expressions or posed smiles is further support for the hypothesised relationship between genuine smiles and cooperation. Together, these findings suggest that there is a basis to conclude that there is preliminary evidence in support of Owren and Bachorowski's theory. That is, there is evidence to indicate that the detection of a genuine smile elicits positive emotion and genuine smiling, and hence, the potential for the formation of a reciprocally cooperative relationship between individuals.

Returning to the theoretical underpinnings of the present research, it is clear that the detection of information specifying a positive emotional state in an interaction partner plays some form of functional role in the coordination of social interaction, and potentially in the establishment and maintenance of reciprocal, mutual cooperation. Individuals exhibiting genuine smiles, as expressions specifying the dispositional properties of a person experiencing a positive emotional state, were interacted with differently, compared to when they were exhibiting physiognomically and ontologically distinct posed smiles. Following McArthur and Baron (1983), it has been suggested that information specifying emotional states can be equated to information specifying social affordances (see Chapter 2). It has been proposed that genuine smiles specify the affordance of cooperability, while posed smiles, as expressions unrelated to emotional state, do not. In this sense, the present data show, as theorised, that the distinct physiognomies of posed and genuine smiles lead individuals to engage with interaction partners exhibiting these expressions in systematically different ways. Specifically, in a situation where interaction was constrained to either competing or cooperating, genuinely smiling individuals were cooperated with more frequently than when they were posing a smile. Thus, it is suggested that there is some basis to conclude that genuine, but not posed smiles, specify the affordance of cooperability. The information specified by the facial expression of an individual experiencing a positive emotional state also specifies an opportunity to cooperate in the context of social exchange. Furthermore, the accurate detection of this affordance property has been shown to elicit positive emotion and genuine smiling in the perceiver (Surakka & Hietanen, 1998), which in turn facilitates further positive emotion, and hence the opportunity for mutual cooperation.

In this sense therefore, it is asserted that positive emotional state does indeed specify affordance-relevant information to the effect that the acquisition of information specifying a positive emotional state in others, together with equivalent information about the self (i.e. an experience of positive emotion) indicates an opportunity for reciprocal cooperative behaviour. The positive relationship between participant genuine smiling and cooperation with genuinely smiling individuals supports this idea. That is, positive emotion, as referenced by genuine smiling, serves here as information about the affordances of the interaction partner, including information for the perceiver about their effectivities. Emotional state serves as a 'common currency', both for detecting opportunities to cooperate with others, and also for indicating such opportunities to others, which together form the reciprocal feed-back loop proposed by Owren and Bachorowski to foster cooperative behaviour. Importantly, the fact that posed smiles did not attract the same levels of cooperation as genuine smiles, and that there was no relationship between participant genuine smiles and cooperation with partners exhibiting a posed smile, indicate that there is some form of safe-guard against cheating within this proposed mechanism for ensuring effective cooperation. Posed smiles, as simulations of a positive emotional state, were not perceived to specify the same potential for cooperation as genuine smiles.

The influence of the order of interactions may also have an interesting ecological interpretation. Overall, it appeared that participants were more accurate[93] in detecting the affordances specified by smiles during the second interaction with the interaction partners exhibiting genuine smiles (i.e. Partners 1 and 2) compared to their first interaction (see above for a description of these results). Perhaps prior exposure to the

[93] When accuracy is considered to be cooperating when interaction partners were genuinely smiling and competing when they were posing a smile.

physiognomy of a particular individual's smile provides some basis for comparison and therefore leads to enhanced attunement to information specified by that individual's facial expressions on subsequent interactions. Given that the manifest appearance of the contraction of facial muscles is likely to vary somewhat between individuals (due to differences in anatomical structure, adipose facial tissue, skin quality, and wrinkling etc.), it may be the case that while social perceivers are generally sensitive to the information specifying disposition by means of facial expressions, sensitivity to particular individuals expressions may require some degree of learning or experience interacting with that individual. In this sense, the participants in Experiment 3 may have in fact, by means of some form of short-term perceptual learning (E. J. Gibson, 1969, 1992), become more attuned to the affordance-relevant information specified by the facial expressions of their interaction partners over time. In other words, participants were better able to take advantage of the information available relevant to each interaction partner individually once they viewed that partner's expression. Presumably, with further experience (i.e. more interactions) there would be more opportunity for perceptual learning and therefore even greater levels of attunement would be expected. This proposal awaits further research.

To summarise, the results of Experiment 3 provide an important contribution to the present research program. On the basis that posed and genuine smiles are ontologically distinct and that perceivers can differentiate between these expressions based on differences in physiognomy, it was proposed that in a functional sense, genuine smiles specify an opportunity to cooperate and posed smiles do not. This hypothesis was tested by requiring participants to engage in a series of one-shot

Prisoners' Dilemma trials with partners exhibiting either neutral facial expressions, posed smiles, or genuine smiles. The results confirmed that participants did indeed perceive more opportunity to cooperate with partners exhibiting genuine smiles than those exhibiting posed smiles as evidenced by their behaviour in these dilemma games. These findings led to the conclusion that posed and genuine smiles do indeed specify distinct sets of social affordances, which are, in turn, used by perceivers to inform behaviour during social exchange situations. Together the results of Experiment 3 represent an original contribution to the social dilemma literature, but more importantly, a novel application of Gibsonian ecological psychology to the study of social interaction and, in particular, the preliminary identification of information specifying the social affordance of cooperability. The final chapter of this thesis will discuss in more detail the implications of the present research with regard to the ecological approach to psychology and social psychology in particular.

CHAPTER 7

Conclusions

Drawing from the contemporary literature regarding the functional aspects of emotion, an argument has been presented suggesting that the accurate detection of the emotional state of conspecifics provides direct adaptive benefit to the social perceiver. Emotional experiences help the individual regulate their interaction with the environment by promoting modes of action readiness relevant to the various events and contingencies with which they are confronted. The likely behaviours and intentions of a highly aroused and angry individual contrast greatly with those expected of someone grieving or otherwise saddened, which are again very different from those of a happy person. On this basis, it was argued that the social perceiver is well served by knowing the emotional status of interaction partners in order to better predict how they may behave, and concomitantly, how they should be interacted with. Approaching the angry person while offering comfort and support is less appropriate (and potentially more injurious) than behaving in the same manner toward the sad individual. However, critical to the effectiveness of such a perception-action cycle is the acquisition of information specifying the emotional state of interaction partners. Although the emotional state of conspecifics is usually readily identifiable, often by means of facial expressions of emotion, it is not always advantageous for individuals to reveal such dispositional information. The goals of the angry person (e.g. inflicting injury to another) may be hindered if they indicate their intentions, perhaps by frowning and baring their teeth in a display of anger, thereby providing an opportunity for the intended target to escape or defend themselves. In this situation, the angry person may well be advantaged by attempting to mask any indicators of anger or even simulating information specifying other emotional states, for example, by smiling. However, for the perceiver to retain the adaptive function accurate social perception offers, they must be sensitive to any differences between information that specifies emotional state, and intentional attempts to simulate or imitate such information without the corresponding emotional experience being present. That is, the social perceiver must be sensitive to the differences between genuine and dissembled expressions of emotion or else risk misperceiving the emotional state of interaction partners, and therefore misperceiving the relevant opportunities for interaction. To address these issues, the present research has focussed on investigating (i) whether social perceivers can differentiate between spontaneous veridical expressions of positive emotion, that is, genuine smiles, and simulations of this expression unrelated to emotional state, that is, posed smiles, and (ii) whether sensitivity to the information that distinguishes these expressions is useful for guiding social interaction.

The current investigation was conducted within the theoretical framework of Gibsonian ecological psychology (see Chapter 2). An important epistemic claim of the ecological approach is that the dispositional properties inherent to an individual's environment, including the objects, people, places and events of that environment, can be directly perceived without recourse to any form of mediation by mental structures (the mental representations and schema of the mind etc.) proposed within the more traditional information processing accounts of psychology. For ecological psychologists, this is a tenable claim in that information is conceived as the arrays of energy that are lawfully structured by, and therefore specify, an environment to an individual. The isometric relationship between, for instance, the surfaces of a piece of fruit, and the structure of the light reflected off those surfaces, precisely specifies the properties (size, shape, ripeness, edibility etc.) of that piece of fruit to a suitably sensitive perceiver (i.e. a perceiver who is sensitive to such structure in the optic array). Thus, meaningful information about the environment is available in the environment, and therefore, once acquired, needs no further elaboration in order for the perceiver to apprehend meaning. In an ontological sense, it is the particular dispositional properties of an object, place, or event that lawfully structure the ambient array and therefore give rise to the information that specifies that object, place, or event to a perceiver. This claim applies equally to the animate (e.g. other people) and the inanimate (e.g. a rock) as both have surfaces that structure the ambient array in a manner whereby information is isomorphically related to disposition.

Hence, a critical initial step in the present research was to ensure that when perceivers were viewing examples of posed and genuine smiles, the information available for detection precisely specified the ontological distinction between these expressions. There is no scope within the present approach to require perceivers to infer, reason, or interpret any information with which they are presented; the information must specify exactly what it means[94]. Thus, any examples of posed and genuine smiles must specify the meaningful distinction between these expressions. That is, genuine smiles must specify a positive emotional state, while posed smiles must *not* specify such a dispositional property. To this end, an original set of facial expressions was generated specifically for use in the present research that met prescribed criteria for ecologically valid facial displays (see Chapter 3 for a full description of the facial display

[94] This does not imply that perceivers cannot 'go beyond' any information that is detected, but that in the context of the present research, any facial displays employed as experimental materials must replicate the relevant information available during the course of an actual real world social interaction, thereby obviating any necessity for inference as an artefact of the experimental materials employed.

generation procedure and the criteria for ecologically valid facial displays that were employed). Essentially, to be considered suitable for use in the present research, any facial expression was required to conform to the established physiognomic markers of posed and genuine smiles (in brief, genuine smiles were required to show evidence of bilateral contraction of the *zygomatic major* and *orbicularis oculi* muscles, while posed smiles were required to only show evidence of *zygomatic major* contraction, see Chapters 1 and 3 for further details), as well as be expressed in the context of the relevant emotional state (i.e. genuine smiles were required to be exhibited in concert with self-reported positive mood, while posed smiles were required to be exhibited in the absence of strong positive affect).[95] To meet these criteria, participants' facial expressions were video taped while they were asked to pose a series of smiles, as well as when they were listening to, and viewing (positively) affectively laden sounds and photographs. Participants were also required to report their mood at various stages during the procedure. Only smiles expressed while viewing or listening to the affective pictures and sounds, and were accompanied by an increase in self-reported mood, and met the criteria for contraction of *zygomatic major* and *orbicularis oculi* were deemed suitable examples of genuine smiles. Alternatively, to be judged a posed smile, an expression was required to be exhibited while intentionally smiling (i.e. when given instructions to smile) and evidence of *zygomatic major* contraction had to be present.

By placing these restrictions on the requirements of the facial displays used in the present research, an adequate level of ecological validity was ensured. In short,

[95] A number of other criteria were also prescribed that related more to ensuring the resultant facial displays were suitable for the purposes of research materials (e.g. ensuring that factors such as gaze-direction and the presence of facial hair or spectacles did not unduly bias perceptions of the facial expressions) rather than specifically to the ecological validity of the displays per se (see Chapter 3 for details).

consistent with an ecological approach to psychology, the dispositional status of the individual provided the ontological basis for the resultant facial expression, and therefore structure in the ambient array of a perceiver (i.e. information) that specified such a disposition precisely. Those expressions considered to be genuine smiles were spontaneously exhibited in a context whereby positive emotion may be expected (i.e. while pictures and listening to sounds that have previously been shown to reliably elicit positive affective responses), were accompanied by a self-reported increase in the positive mood, and conformed to reliable physiognomic markers of a positive emotional experience. In contrast, posed smiles were deliberately expressed in a context when a positive affective experience is less likely (e.g. posing for a drivers license photograph, albeit an imaginary one) and did not contain physiognomic information specific to genuine smiles. Thus, by systematically varying the dispositional properties of the individuals exhibiting the target expressions, and verifying the resultant facial expressions according to established physiognomic criteria (e.g. FACS ratings), it is reasonable to assume that the facial expressions generated for use in the present research adequately replicated the information available to perceivers during naturalistic, real world, social interactions. In other words, the facial displays employed in the present research were of an adequate level of ecological validity to enable generalisation from the laboratory to actual social interaction.

The subsequent step in the present research was to provide an initial investigation into whether perceivers were sensitive to the meaningful differences between posed and genuine smiles, or alternatively, simply deemed these expressions equivalent. Although scant, the previous research that has considered this issue has generally indicated that perceivers do in fact differentiate between posed and genuine smiles. However, much of this research has suffered from methodological shortcomings that, while not critical to the research as a whole, have tended to undermine the generalisability of the results reported (see Chapters 4 and 5 for reviews). To overcome these problems, Experiments 1a, 1b, and 2 of the present research were intended to replicate and extend the previous literature. Experiments 1a and 1b employed a modified form of a signal detection task to investigate whether perceivers could accurately categorise neutral expression, posed smiles, and genuine smiles as reflecting happiness (or not). The results here revealed that although judgments were typically accompanied by a degree of bias (see Chapter 4), perceivers could, overall, accurately determine which expressions were specific to the experience of happiness, regardless of whether the judgments were made from photographs (i.e. static expressions) or videos (i.e. dynamic expressions). On this basis, Experiment 2 was conducted in order to establish whether such sensitivity was manifest when participants were not provided with any explicit instruction or direction to attend to facial expressions or emotional states. This study employed a priming procedure whereby participants were required to classify a target word as positive or negative. Each target word was preceded by a facial expression prime. The results again revealed that perceivers were sensitive to the meaningful differences between posed and genuine smiles. The identification of positive target words was facilitated by prior exposure to a genuine smile, but not a posed smile. Taken together and in concert with the previous research, it was suggested that the findings revealed in Experiments 1a, 1b and 2 provide evidence to conclude that perceivers can differentiate between posed and genuine smiles on the basis of experienced positive emotional state, and in fact, remain sensitive to this distinction even without an explicit goal to evaluate emotional state.

An important finding to emerge from these initial experiments (specifically E1a and E1b) concerned the role of the exposure of the teeth in the context of a smile. While perceivers were very accurate when distinguishing posed from genuine closed mouth smiles (i.e. smiles that do not expose the teeth), a consistent bias towards misidentifying posed smiles as genuine smiles was found for judgments of open mouth smiles. It appears that the exposure of the teeth during a smile, although irrelevant to the detection of smile veracity (i.e. the teeth can be exposed during a genuine smile, but are not specific to genuinely smiling), can lead to the misperception of a posed smile as a genuine smile. This finding has some parallel to that reported by Frank, Ekman and Friesen (1993), who suggested that factors associated with increasing the physiognomic prominence of *orbicularis oculi* contraction (e.g. low intensity *zygomatic major* contraction) resulted in greater accuracy when distinguishing posed from genuine smiles. The exposure of the teeth during the course of a smile may simply result from individual differences in facial morphology in that for some people moderately intense *zygomatic major* contraction can raise the upper lip and thereby expose the teeth. Often when *zygomatic major* is contracted at a moderate (or greater) intensity the cheeks are pushed upwards toward the eyes causing the bagging of skin below the eye orbits (Ekman, Friesen, & Hager, 2002), and a change in physiognomic appearance similar to that when *orbicularis oculi* is contracted (Frank et al.). Thus, participants who incorrectly identified posed smiles with the teeth exposed as genuine smiles may have in fact been attuned to properties of the facial displays non-specific to smile veracity due to their morphological similarity to information specific to smile veracity. Such attunement to task-irrelevant information was therefore misinformative with respect to judging smile veracity and consequently resulted in dysfunctional perceptions regarding the presence or absence of positive emotional state.

It is important to note that this is not to infer that the detection of smile veracity occurred in some form of probabilistic manner. The information that specifies *orbicularis oculi* contraction *can* be distinguished from that resulting from moderate to high intensity *zygomatic major* contraction (Ekman et al., 2002) although differences between these facial features may be very subtle. Indeed, the bias associated with the display of teeth in Experiments 1a and 1b was by no means unanimous across either participants or target expressions. Hence, individual differences in attunement, perhaps akin to differing degrees of social perception expertise among participants, as well as the varying physiognomies of the target facial displays are likely to have contributed to the variance in bias observed. To return to Kahneman's (1973) notion of perceptual readiness (see Chapter 4), it is suggested that for those participants who were (assumed to be) less sensitive to the information specifying positive emotional state, smiles with the teeth exposed (and therefore contained wrinkling below the eyes as a function of *zygomatic major* contraction) were essentially ambiguous in terms of information specifying emotional state (i.e. these participants were unable to differentiate the subtle distinctions between moderate intensity *zygomatic major* contraction and *orbicularis oculi* contraction). This situation is similar to the example of the Ames distorted room aforementioned, although here there is information specific to emotional state, but it is suggested that some perceivers are not sufficiently sensitive to detect it. For some participants posed smiles with the teeth exposed were essentially seen as genuine smiles, because, without sufficient information available to determine veracity, any expression with the characteristic upturned mouth of a smile and wrinkling around the eyes is seen as consistent with the information that specifies a genuine smile and, indeed, positive emotional state.

On the basis that perceivers can determine the ontological status of posed and genuine smiles, a third experiment was conducted to investigate whether such sensitivity has a functional role in guiding effective social interaction. In Experiment 3, participants were required to play several rounds of the Prisoners' Dilemma game with partners (actually video recordings) exhibiting neutral expressions, posed smiles, and genuine smiles. This experimental set-up was employed in part as an initial assessment of a recent evolutionary theory regarding the functional aspects of posed and genuine in social interaction (Owren & Bachorowski, 2001). In short, Owren and Bachorowski proposed that genuine smiles function to elicit reciprocal cooperation from interaction partners. In fact, mutual or reciprocal cooperation has posed a conceptual problem to social scientists for some time to the effect that any indication of a willingness to cooperate may simultaneously serve as an indicator of an opportunity for exploitation by interaction partners. Owren and Bachorowski argued that by means of accurately detecting information specific to a positive emotional state (i.e. a genuine smile), the social perceiver in fact initiates a feedback loop whereby they too experience positive emotion. As a result they also exhibit a genuine smile, which in turn provides information specific to this dispositional state back to the original smiling individual. Thus, the shared positive emotional state between interaction partners and, in particular, the acquisition of information specific to this relationship, provides a means for each party involved in the interaction to engage in cooperative behaviour with a similarly committed other.

The results of Experiment 3 supported the proposition of Owren and Bachorowski's (2001). Participants were significantly more likely to cooperate with an interaction partner who was exhibiting a genuine smile, than an interaction partner who was exhibiting a posed smile. Furthermore, the perceptual bias manifest in terms of a tendency to misidentify posed smiles with the teeth exposed as genuine smiles, which was reported for Experiments 1a and 1b, was also influential in Experiment 3. Participants were more likely to cooperate with partners exhibiting open mouth posed smiles compared to closed mouth posed smiles. These are important findings within the context of the present research as it represents the first empirical demonstration of the functional role of sensitivity to smile veracity within social interaction. Furthermore, this effect was demonstrated by using an experimental procedure with a level of ecological validity that was adequate, it is argued, to enable generalisation beyond the laboratory setting to naturalistic social interactions. Both in the facial displays employed (see above and Chapter 3) as well as the constraints on and realism inherent to the interaction situation (see Chapter 6) approximated well to the reference situation of an actual social interaction. Hence, there is reason to suggest that the behavioural outcomes associated with the veracity of smiles exhibited by interaction partners within a social dilemma situation (i.e. specifically, a general tendency to cooperate when a genuine smile was exhibited and compete when a posed smile was exhibited) should also be observable during regular real-world social interactions. In this sense, it is suggested that facial expressions provide a means to identify conspecifics with whom cooperation does not risk exploitation. Genuine smiles, as expressions that specify the dispositional properties of an individual experiencing a positive emotional state, are used to identify those interaction partners who are likely to be motivated and committed to cooperate, thereby initiating the establishment of a reciprocally cooperative interaction. Alternatively, posed smiles, as expressions unrelated to positive emotion state, do not call forth cooperative behaviour, and may in fact, facilitate competitive modes of interaction.

The results of Experiment 3 are also very pertinent to a functional ecological conceptualisation of social perception and interaction. Beyond the claim of information as lawfully structured energy arrays specific to the objects, places, and events of the environment, Gibson (1979) introduced the concept of affordances, that is, the opportunities for acting and interacting specified by the available information relative to the individual (see Chapter 2). Related to the present research, McArthur and Baron (1983) have suggested that information specifying emotional states can be equated to information specifying social affordances. Specifically, it has been argued here that positive emotional states, exhibited in this case by a facial expression (i.e. a genuine smile), specify an opportunity to cooperate with a conspecific, while posed smiles, as expressions unrelated to emotional state, specify a distinctly different set of affordances. Consistent with Runeson and Frykholm's (1983; 1986) KSD principle (see Chapter 2), the dispositional properties underlying posed and genuine smiles (i.e. positive emotion versus intention) constrain the kinematic patterns and, therefore, the morphological appearance of these facial expressions. This is an important ontological claim in that by linking disposition directly to physiognomy there is a robust theoretical basis to contend that an isomorphic relationship exists between the emotional state (or alternatively, intentions and motivations) of an individual and their facial expression. In turn, these expressions modulate the ambient (optical) array and specify, to an attuned social perceiver, this dispositional information and, therefore, disposition-relevant opportunities for interaction relative to the smiling individual.

The results of Experiment 3 provide evidence that perceivers are able to use the different dispositional information specified by posed and genuine smiles respectively, to guide interaction. More specifically, when information specifying positive emotional state was available, cooperation in the Prisoners' Dilemma scenario was facilitated. By contrast, when no such information was available (i.e. the interaction partner was exhibiting a posed smile) competitive interactions were more likely. Drawing from Owren and Bachorowski's (2001) 'selfish-gene' theory regarding the evolutionary functions of posed and genuine smiles (see Chapters 1, 2, and 6), and consistent with the Gibsonian monistic unit of analysis for psychology (i.e. the animal-environment interaction), it has been argued that the role of information specifying an opportunity to cooperate (i.e. information specifying a positive emotional state) extends beyond a specification of a simple environmental property. Here, positive emotional state is simultaneously a guide to identifying suitable partners for reciprocally cooperative interactions, as well as information that guides the individual to interact cooperatively. In this sense, information specifying positive emotional state and, therefore, cooperability, is expropriospecific (Lee, 1978, 1980). It specifies the relationship *between* the individual and their environment (in this case another individual within the environment) relevant to available opportunities to interact (i.e. competition or cooperation). The presence of positive emotion, as information for the affordance of cooperability, *points both ways*, implicating both the perceiver and the referent of perception in a perception-action cycle, and setting the occasion for mutual cooperation. A shared positive emotional state provides information by which fellow cooperators can be identified, as well as information relevant to an intention to cooperate. Acquisition of this information is likely to lead to cooperative interaction by suitably motivated individuals, as demonstrated by the results of Experiment 3.

To conclude, the present program of research provided novel empirical evidence to illustrate that social perceivers can detect the meaningful ontological distinctions between posed and genuine smiles. Furthermore, it was also shown that such sensitivity is manifest in terms of functionally adaptive behaviour relevant to the opportunities to interact with smiling individuals. These results are believed to be the first rigorous empirical demonstration of the behavioural outcomes associated with the accurate perception of the emotional state specified by posed and genuine smiles respectively. Finally, the application of an ecological framework, specifically that of Gibsonian ecological psychology, to the study of social perception provides both theoretical and methodological innovation. It is suggested that the Gibsonian ecological view can lead to a more conceptually coherent account of psychological activity than currently offered by the information processing accounts of the dominant cognitivist approach evident within contemporary psychological research and theorising.

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Appendix A: Facial Action Coding System (Ekman et al., 2002) criteria for assessing contraction of Action Unit 12 (*zygomatic major* contraction) and Action Unit 6 (*orbicularis oculi* contraction).

Action Unit 12 – Lip Corner Puller

The muscle underlying AU 12 emerges high up in the lower face by the cheek bones and attaches at the corner of the lips. In AU 12, the direction of the action is to pull the lip corners up towards the cheek bone in an oblique direction.

Appearance Changes due to AU12

1. Pulls the corners of the lips back and upward (obliquely) creating a shape to the mouth.
2. Deepens the nasolabial furrow, pulling it laterally and up. The skin adjacent to the nasolabial furrow is raised up and laterally.
3. In a weak to moderate 12, there is some raising of the infraorbital triangle and there may be some deepening of the infraorbital furrow.
4. In a strong action, one or more of the following:
   a. The infraorbital triangle push upwards is more evident.
   b. The infraorbital furrow deepening is more evident.
   c. Bags the skin below the lower eyelid.
   d. Narrows the eye aperture by pushing up the cheek and skin below the lower lid.
   e. Produces crow's feet at eye corners.
   f. May raise and widen the nostrils.
   g. May flatten and stretch the skin on the chin boss.
5. Almost all of the appearance changes listed under 4 above (with the exception of changes f. and g.) can also be produced by AU 6 in the upper face. When you see a strong action of 12, often it is difficult to be certain whether the changes listed under change 4 above are due to 12 alone or to the combination of 6 plus 12 because a strong 12 hides many of the effects of 6. When the action of 12 is weak to moderate the appearance changes under 4 above do not occur, unless AU 6 has been added. With such weak to moderate actions of 12 you score 12 or 6+12 based upon whether the evidence of AU 6 is apparent. In either case, it is important to determine whether the appearances should be scored as 12 or 6+12.

Intensity Scoring for AU 12

AU 12A

The appearance changes for AU 12 are sufficiently present to indicate AU 12, but are insufficient to score 12B (e.g., a *trace* of raising of skin in the lower/middle nasolabial furrow area and a *trace* of lip corners elongated and angled up). You should emphasize detecting the oblique upward movement of the lip corners in low intensity 12s that changes the angle of the lip corners. Note that neither AU 6 or 11 changes the angle of the lips, as does 12.

AU 12B

1. Skin in the area of the lower-middle portion of the nasolabial furrow or the furrow itself has been raised up and laterally *slightly*. If the nasolabial furrow is permanently etched, it usually deepens with a 12B, but the crucial change is that the skin in this area shifts obliquely. If the nasolabial furrow is not permanently etched, it may not appear with 12B.
   and
2. *Slight* evidence that infraorbital triangle has been raised; most likely showing in lifting and puffing out of lateral top corner of infraorbital triangle.
   and
3. *Slight* evidence that lip corners elongated and angled up. If upward angle is permanent, it must increase *slightly*. Note that when 6 is added to 12B there often is more evidence of the nasolabial furrow deepening than in 12B without 6, and the excursion of the lip corners is small in comparison to the extent of crow's feet wrinkles. Note that appearance changes 1 and 2, as expressed in words, could be due to AU 6, rather than AU 12. However, the appearance of 6 is noticeably different from 12. Furthermore, the appearance of 6 and 6+12 also differ. If there are other signs of AU 6, inspect carefully for change 3 to score AU 12.

AU 12C

All three criteria for 12B above are present and all are at least *marked*, but the evidence is less than the criteria for 12D.

AU 12D

Appearance changes 1 (lip corners raised obliquely to make U shape), 2 (deepened nasolabial furrow and oblique movement of skin in that area), and 4 in 12secA are all at least *severe*, but the evidence is less than the criteria for 12E.

AU 12E

Appearance changes 1 (lip corners raised obliquely to make U shape), 2 (deepened nasolabial furrow and oblique movement of skin in that area), and 4 (infraorbital triangle raise, infraorbital furrow deepening, in 12secA must be *extreme* to *maximum*.

Action Unit 6 – Cheek Raiser and Lid Compressor

The muscle underlying AU 6 circles the eye orbit, with a circumference that extends into the eyebrow and below the lower eye furrow. Action Unit 6 pulls skin towards the eye.

A. Appearance Changes due to AU 6

1. Draws skin towards the eye from the temple and cheeks as the outer band of muscle around the eye constricts.
2. Raises the infraorbital triangle, lifting the cheek upwards.
3. Pushes the skin surrounding the eye towards the eye socket, which can narrow the eye aperture, bag or wrinkle the skin below the eye, and push the eye cover fold down and/or change its shape.
4. May cause crow's feet lines or wrinkles to appear, extending radially from the outer corners of the eye aperture.
5. Deepens the lower eyelid furrow.
6. May lower lateral portion of the eyebrows to a small extent.
7. A strong AU 6 may:
  a. Make evident or deepen the nasolabial furrow.
  b. Raise the outer portions of the upper lip to a small extent.
  c. Make evident or deepen the infraorbital furrow, so that this wrinkle runs across the top of the infraorbital triangle in a straight or crescent-like shape.

8. If there is evidence of 6 on one side of the face and 7 on the other side, score it as a bilateral 6, unless you are scoring the asymmetry of 6 and 7.

Intensity Scoring for AU 6

AU 6A
The appearance changes for AU 6 are sufficiently present to indicate AU 6, but are insufficient to score 6B (e.g., *slight* crow's feet or *slight* cheek raise).

AU 6B
Marked change on either criterion 1 or 2 below or *slight* on both 1 and 2 is sufficient to score 6B.
1. Crow's feet wrinkles; if present in neutral, they must increase.
or
2. Infraorbital triangle raise: cheeks up, infraorbital furrow deepened, and bags or wrinkles under eyes; if present in neutral, the furrow and either bags or wrinkles under the eyes must increase.

AU 6C
The crow's feet wrinkling and infraorbital triangle raising criteria for 6B are both present and both are at least *marked*, but the evidence is less than the criteria for 6D.

AU 6D
The crow's feet wrinkling and infraorbital triangle raising criteria for 6B are both present and both are at least *severe*, but the evidence is less than the criteria for 6E.

AU 6E
Crow's feet wrinkling and infraorbital triangle raising are both present, with the infraorbital triangle and cheek raising in the *maximum* range.

L6+R7 or R6+L7: If 6 can be scored on one side of the face and 7 on the other side, score as bilateral 6, unless you are scoring asymmetry.

Appendix B: Analogue mood scale

Participant #:

Sex:

Date:

Please indicate with a line(——) your current mood on the vertical bar below:

Very Positive

Neutral

Very Negative

Appendix C: Overview of procedure and materials for generation of facial displays

Phase		*Part*	*Description*	
Intro			Welcome & instructions	
			Mood scale 1	
1	Neutral	a	neutral expression	
			Mood scale 2	
2	Posed smile	a	smile	
		b	passport photo	
		c	family portrait	
		d	photo with PM	
		e	photo for CV	
		f	photo for drivers licence	
			Mood scale 3	
			Instructions	
3	Mood indctn.	a	Classical music: Allegro movements (4:05 minutes)	
			- Mozart *Divertimento #136*	
			- Vivaldi *Concerto…g major*	
			- Mozart *Eine Kleine Nacht Musik*	
			Mood scale 4	
			Instructions	
			Males	*Females*
4	Genuine smile 1	a	cardinal (116)	choir (812)
	(IADS #)	b	rock and roll (815)	rock and roll (815)
		c	erotic female (201)	baseball (353)
		d	sport crowd (352)	boy laugh (220)
		e	boy laugh (220)	erotic couple (215)
		f	funk music (820)	funk music (820)
		g	baby laugh (110)	male laugh (221)
		h	applause (351)	applause (351)
		i	erotic female (202)	baby laugh (110)
		j	baseball (353)	erotic female (201)
		k	erotic couple (215)	applause (401)
			Mood scale 5	
			Instructions	
5	Genuine smile 2	a	kitten (1460)	garden (5760)
	(IAPS #)	b	erotic couple (4607)	dolphin soccer (1920)
		c	snow skiing (8190)	seal (1440)
		d	erotic female (4180)	baby (2050)
		e	baby (2050)	kitten (1460)
		f	rabbits (1750)	puppies (1710)
		g	baby (2040)	baby (2057)
		h	dolphin soccer (1920)	rabbit (1610)

i	baby (2070)	rabbits (1750)
j	erotic female (4220)	baby (2040)
k	babies (2080)	ladies (2395)
l	erotic female (4250)	erotic couple (4607)
m	puppies (1710)	sunset (5830)
n	erotic female (4210)	baby (2058)
o	erotic female (4232)	baby (2070)
p	seal (1440)	babies (2080)
q	erotic couple (4664)	children (2091)
r	erotic couple (4652)	snow skiing (8190)
s	car (8510)	man and baby (2165)
t	baby (2260)	grandfather and kids (2340)

Mood scale 6
END.

Appendix D: Overview of coding of smiles using FACS action units 12 and 6 for each participant for the facial display generation procedure.

Table D1: Female participant 1 (F1) facial display generation procedure results

PHASE		AU12?	AU6?	Other AUs?
1a		n		
2a		y	n	
2b		y	n	
2c		y	n	
2d		y	n	
2e		y	n	
2f		y	n	
4a		n	n	
4b		y	y	
4c		n		
4d		n		
4e		y	n	
4f		n		
4g		n		
4h		n		
4i		y		
4j		n		
4k		n		
5a		n		
5b		n		
5c		n		
5d		n		
5e		n		
5f		n		
5g		y	n	
5h		n		
5i		n		
5j		n		
5k		n		
5l		n		
5m				
5n				
5o				
5p				
5q				
5r				
5s				
5t				

Total Posed: 9 Total Genuine: 1

Table D2: Female participant 2 (F2) facial display generation procedure results

PHASE		AU12?	AU6?	Other AUs?
1a		n		
2a		y	n	y
2b		y	n	y
2c		y	n	
2d		y	n	
2e		y	n	
2f		y	n	
4a		n		
4b		y	?	
4c		n		
4d		y	n	
4e		n		
4f		n		
4g		y	n	
4h		n		
4i		y	n	
4j		y	n	
4k		n		
5a		n		
5b		y	n	
5c		y	n	
5d		n		
5e		n		
5f		n		
5g		y	n	
5h		y	n	
5i		y	n	
5j		y	n	
5k		y	n	
5l		y		
5m		y	n	
5n		n		
5o				
5p				
5q				
5r				
5s				
5t				

Total Posed: 20

Total Genuine: 0

Notes:

Table D3: Female participant 3 (F3) facial display generation procedure results

PHASE		AU12?	AU6?	Other AUs?
1a		n		
2a		y	n	
2b		y	n	
2c		y	n	
2d		y	n	
2e		y	n	
2f		y	n	
4a		n		
4b		n		
4c		n		
4d		y		
4e		y		
4f		y		
4g		n		
4h		n		
4i		y		
4j		y		
4k		y		
5a				
5b		y		
5c				
5d				
5e				
5f				
5g				
5h				
5i				
5j				
5k				
5l				
5m				
5n				
5o				
5p				
5q				
5r				
5s				
5t				

Total Posed: 13

Total Genuine: -

Notes: Hair occluded AU6 area, could not code Phases 4 and 5.

Table D4: Female participant 4 (F4) facial display generation procedure results

PHASE		AU12?	AU6?	Other AUs?
1a		n		
2a		y	n	
2b		y	y	
2c		y	n	
2d		y	n	
2e		y	n	
2f		y	n	
4a		n		
4b		n		
4c		n		
4d		y	n	
4e		n		
4f		n		
4g		n		
4h		n		
4i		y	n	
4j		n		
4k		n		
5a		n		
5b		y	n	
5c		n		
5d		n		
5e		y	n	y
5f		y	n	
5g		n		
5h		n		
5i		n		
5j		n		
5k		n		
5l		y	n	
5m		n		
5n		n		
5o		y	y	y
5p		y	n	
5q		y	n	
5r		n		
5s		n		
5t		n		

Total Posed: 13

Total Genuine: 2

Notes:

Table D5: Female participant 5 (F5) facial display generation procedure results

PHASE		AU12?	AU6?	Other AUs?
1a		n		
2a		y	n	
2b		y	n	
2c		y	n	
2d		y	n	
2e		y	n	
2f		n		
4a		n		
4b		y	y	
4c		y	n	
4d		y	y	
4e		y	y	
4f		y	y	
4g		y	n	
4h		y	n	
4i		y	y	
4j		y	y	
4k		n		
5a		n		
5b		y	n	
5c		n		
5d		n		
5e		n		
5f		y	n	
5g		y	n	
5h		n		
5i		n		
5j		n		
5k		n		
5l		y	n	
5m		n		
5n		n		
5o		n		
5p		n		
5q		n		
5r		n		
5s		n		
5t		y		

Total Posed: 13

Total Genuine: 6

Notes:

Table D6: Female participant 6 (F6) facial display generation procedure results

PHASE		AU12?	AU6?	Other AUs?
1a		n		
2a		y	?	
2b		y	n	
2c		y	y	
2d		y	n	
2e		y	y	
2f		y	n	
4a		n		
4b		y	y	
4c		n		
4d		y	?	
4e		y	y	
4f		y	?	y
4g		y	n	
4h		y	y	
4i		n		
4j		n		
4k		y	n	
5a		y	n	
5b		y	y	
5c		y	y	
5d		y	y	
5e		y	y	
5f		y	y	
5g		y	y	
5h		y	y	
5i		y	n	
5j		y	n	
5k		y	n	
5l		n		
5m		y	n	
5n		y	y	
5o		y	y	
5p		y	y	y
5q		y	n	
5r		n		
5s		y	y	
5t		y	n	

Total Posed: 14

Total Genuine: 16

Notes:

Table D7: Female participant 7 (F7) facial display generation procedure results

PHASE		AU12?	AU6?	Other AUs?
1a		n		
2a		y	n	
2b		y	n	
2c		y	n	
2d		y	n	
2e		y	n	
2f		y	n	
4a		y	n	
4b		y	y	y
4c		y	n	
4d		y	n	
4e		y	n	
4f		n		
4g		y	n	
4h		n		
4i		y	n	
4j		n		
4k		y	y	
5a		n		
5b		y	n	
5c		y	n	
5d		y	n	
5e		n		
5f		y	n	
5g		y	n	
5h		n		
5i		y	n	
5j		n		
5k		n		
5l		y	n	
5m		n		
5n		y	n	
5o		n		
5p		y	n	
5q		y	n	
5r		y	n	
5s		n		
5t		y	n	

Total Posed: 24

Total Genuine: 2

Notes:

Table D8: Female participant 8 (F8) facial display generation procedure results

PHASE		AU12?	AU6?	Other AUs?
1a		n		
2a		y	y	y
2b		y	n	
2c		y	y	
2d		y	n	
2e		y	?	
2f		y	n	
4a		n		
4b		n		
4c		n		
4d		n		
4e		y	y	
4f		n		
4g		n		
4h		n		
4i		n		
4j		y	n	
4k		n		
5a		n		
5b		n		
5c		n		
5d		n		
5e		n		
5f		n		
5g		n		
5h		n		
5i		n		
5j		n		
5k		n		
5l		n		
5m		y	n	
5n		n		
5o		n		
5p		n		
5q		n		
5r		n		
5s		n		
5t		n		

Total Posed: 6

Total Genuine: 3

Notes:

Table D9: Male participant 1 (M1) facial display generation procedure results

PHASE		AU12?	AU6?	Other AUs?
1a		n		
2a		y	n	
2b		y	n	
2c		y	n	
2d		y	n	
2e		y	n	
2f		n		
4a		n		
4b		y	n	
4c		n		
4d		n		
4e		y	?	
4f		n		
4g		n		
4h		n		
4i		n		
4j		n		
4k		y	n	
5a		y	?	
5b		y	n	
5c		n		
5d		n		
5e		n		
5f		n		
5g		n		
5h		n		
5i		n		
5j		n		
5k		n		
5l		n		
5m		n		
5n		n		
5o		n		
5p		n		
5q		y	n	
5r		n		
5s		n		
5t		n		

Total Posed: 11

Total Genuine: 0

Notes:

Table D10: Male participant 2 (M2) facial display generation procedure results

PHASE		AU12?	AU6?	Other AUs?
1a		n		
2a		y	n	
2b		y	n	
2c		n		
2d		n		
2e		n		y
2f		n		
4a		n		
4b		n		
4c		n		
4d		n		
4e		y	n	
4f		y	n	
4g		y	n	
4h		n		
4i		y	y	
4j		y	n	
4k		y	n	
5a		n		
5b		y	n	y
5c		n		
5d		n		y
5e		n		
5f		n		
5g		n		
5h		y		
5i		y		
5j		n		
5k		n		
5l		n		
5m		y	n	
5n		n		
5o		n		
5p		n		
5q		n		
5r		n		
5s		n		
5t		n		

Total Posed: 11

Total Genuine: 1

Notes:

Table D11: Male participant 3 (M3) facial display generation procedure results

PHASE		AU12?	AU6?	Other AUs?
1a		n		
2a		y	n	
2b		y	n	
2c		y	?	
2d		y	n	
2e		y	n	
2f		y	n	
4a		n		
4b		y	y	
4c		y	?	
4d		n		
4e		y		
4f		y	n	
4g		y	n	
4h		n		
4i		n		
4j		n		
4k		y		
5a		n		
5b		y		
5c		n		
5d		n		
5e		n		
5f		n		
5g		y	n	
5h		y	?	
5i		n		
5j		n		
5k		n		
5l		y	n	
5m		n		
5n		y	n	
5o		n		
5p		n		
5q		y	n	
5r		y	y	
5s		n		
5t		n		

Total Posed: 18

Total Genuine: 2

Notes:

Table D12: Male participant 4 (M4) facial display generation procedure results

PHASE		AU12?	AU6?	Other AUs?
1a		n		
2a		y	n	
2b		y	n	
2c		y	n	
2d		y	n	
2e		n		
2f		y		
4a		n		
4b		y	n	
4c		n		
4d		n		
4e		n		
4f		n		
4g		n		
4h		n		
4i		y	y	?
4j		n		
4k		y	y	y
5a		n		
5b		y	y	y
5c		n		
5d		y	n	
5e		y	y	y
5f		n		
5g		n		
5h		n		
5i		n		
5j		n		
5k		n		
5l		n		
5m		n		
5n		y	y	y
5o		n		
5p		n		
5q		n		
5r		n		
5s		n		
5t		n		

Total Posed: 7

Total Genuine: 5

Notes:

Table D13: Male participant 5 (M5) facial display generation procedure results

PHASE		AU12?	AU6?	Other AUs?
1a		n		
2a		n		
2b		y	n	
2c		n		
2d		y	n	
2e		n		
2f		n		
4a		n		
4b		y	n	
4c		y	y	y
4d		n		
4e		n		
4f		y	n	
4g		n		
4h		n		
4i		n		
4j		n		
4k		y	y	y?
5a		n		
5b		y	y	y
5c		n		
5d		y	y	y
5e		n		
5f		n		
5g		n		
5h		n		
5i		n		
5j		n		
5k		n		
5l		n		
5m		n		
5n		y	?	
5o		n		
5p		n		
5q		n		
5r		y	n	
5s		n		
5t		n		

Total Posed: 6

Total Genuine: 4

Notes:

Table D14: Summary of facial display generation procedure results for all participants

Participant		Posed smiles	Genuine smiles	Total smiles
F1		9	1	10
F2		20	0	20
F3[ab]		13	-	13
F4[b]		13	2	15
F5		13	6	19
F6		14	16	30
F7		24	2	26
F8		6	3	9
M1		11	0	11
M2		11	1	12
M3		18	2	20
M4		7	5	12
M5		6	4	10
Total		165	42	207

[a] No genuine smiles could be coded for this participant as her hair occluded the AU6 (*orbicularis oculi*) region during phases 4 and 5 of the facial display generation procedure.

[b] These participants did not meet the criteria for an increase in self-reported mood during the genuine smile phases of the procedure. Hence no genuine smiles from these participants were considered for use in the present research.

Appendix E: Graphs of self-reported mood for each participant in the facial display generation procedure.

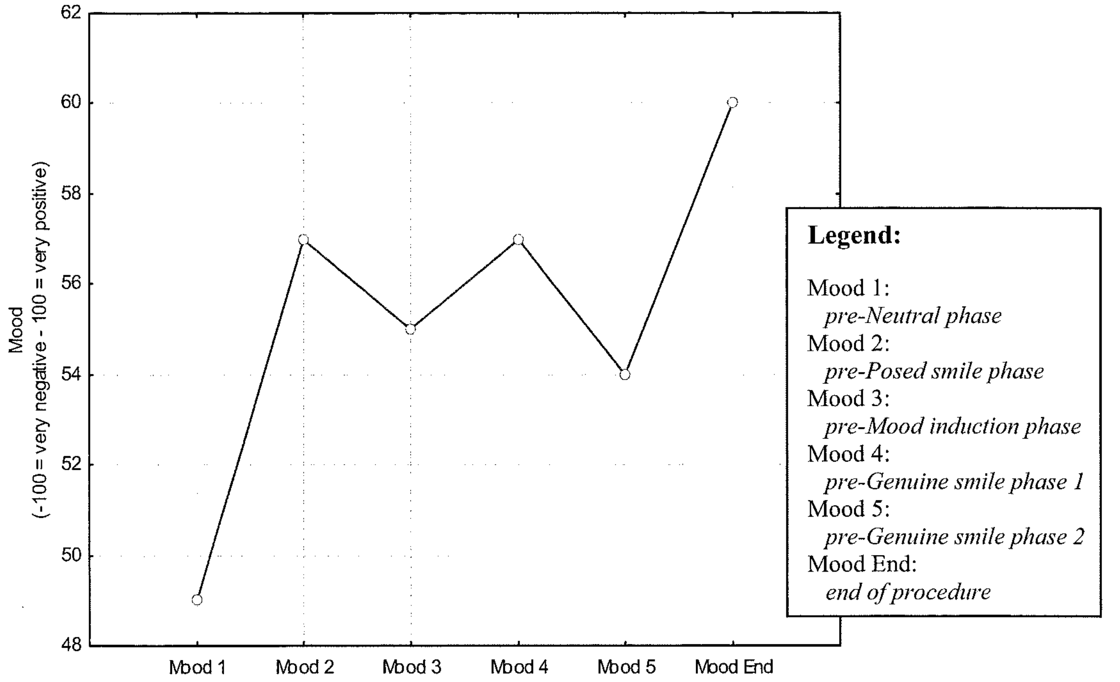

Figure E1: Participant F1

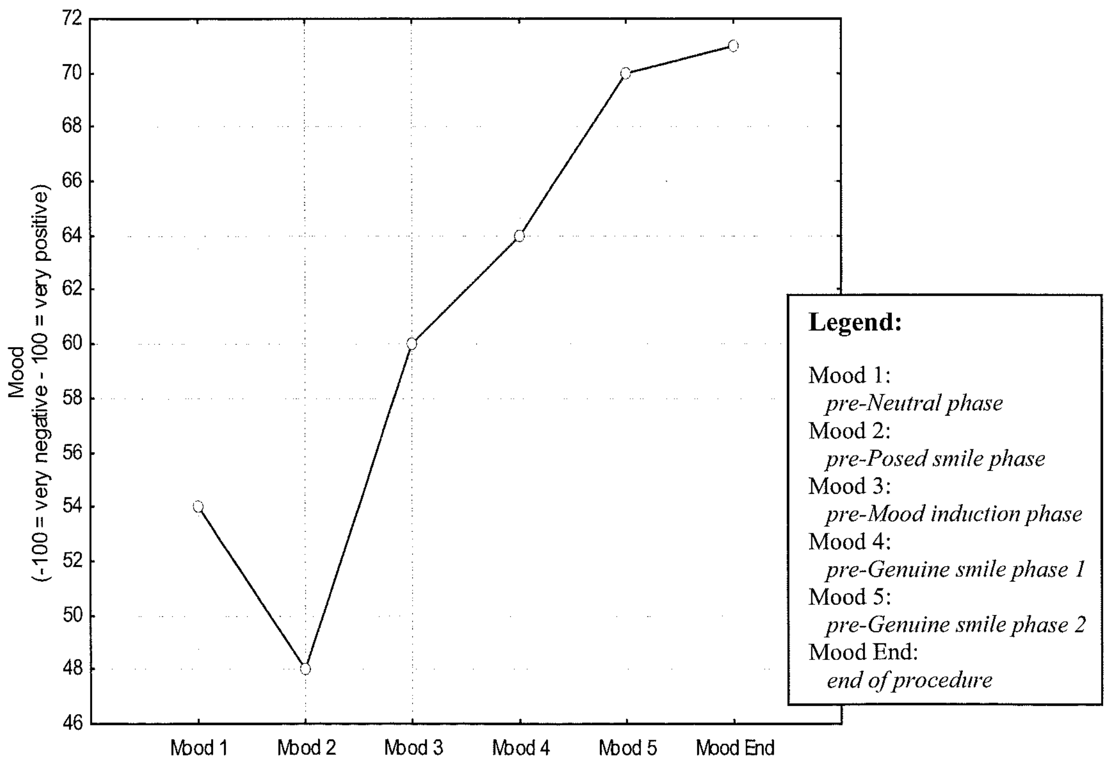

Figure E2: Participant F2

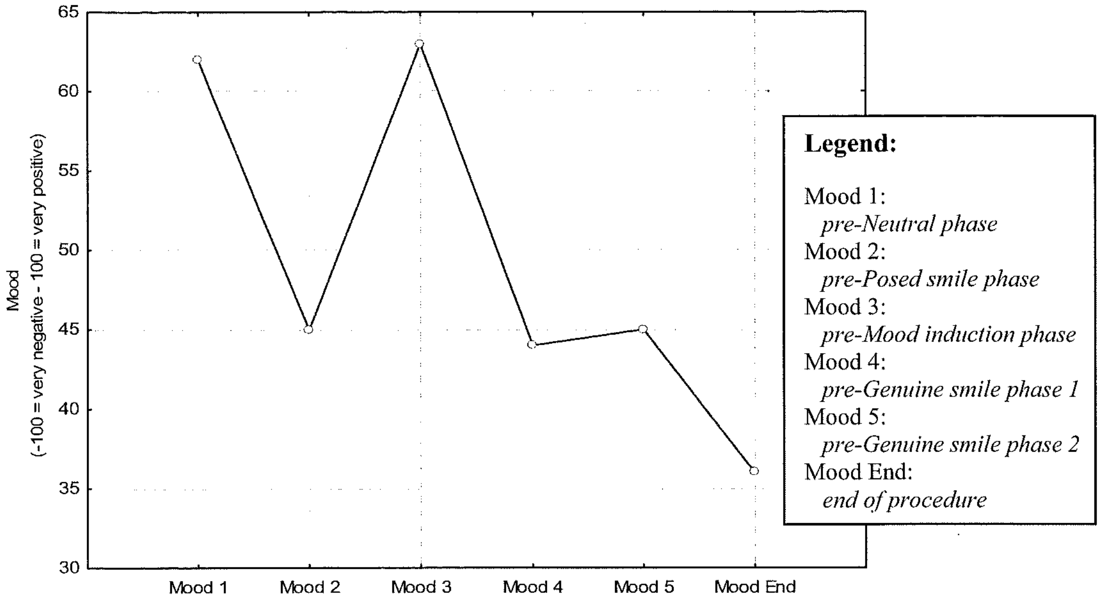

Figure E3: Participant F3

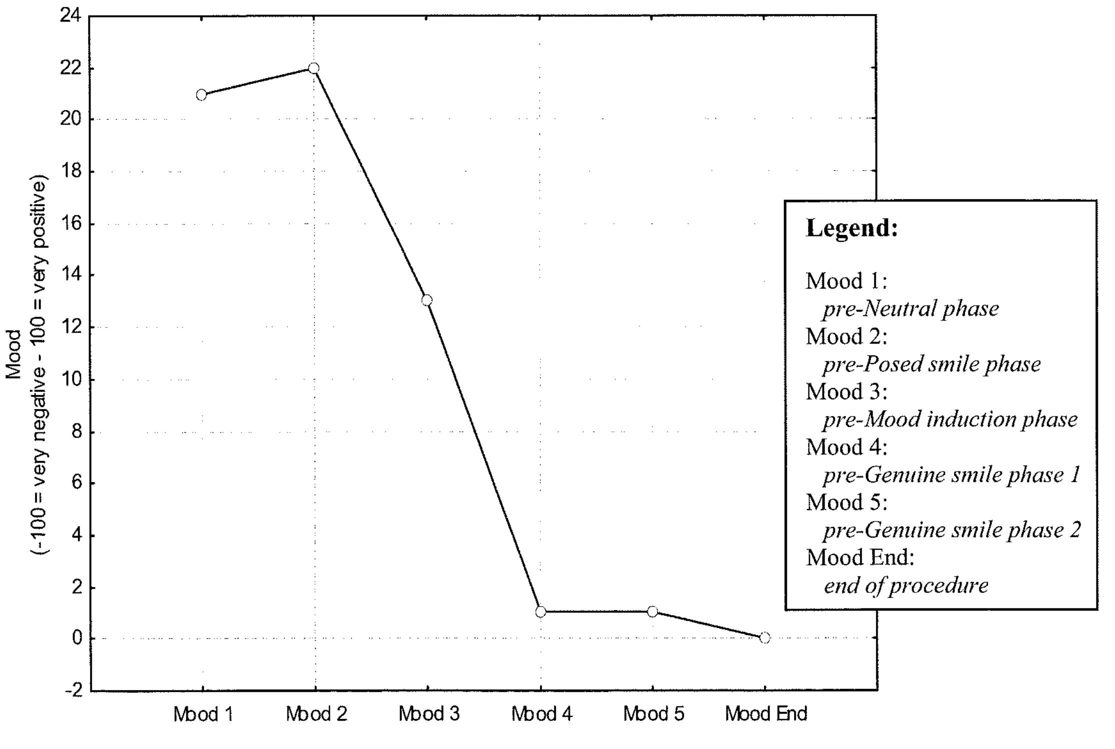

Figure E4: Participant F4

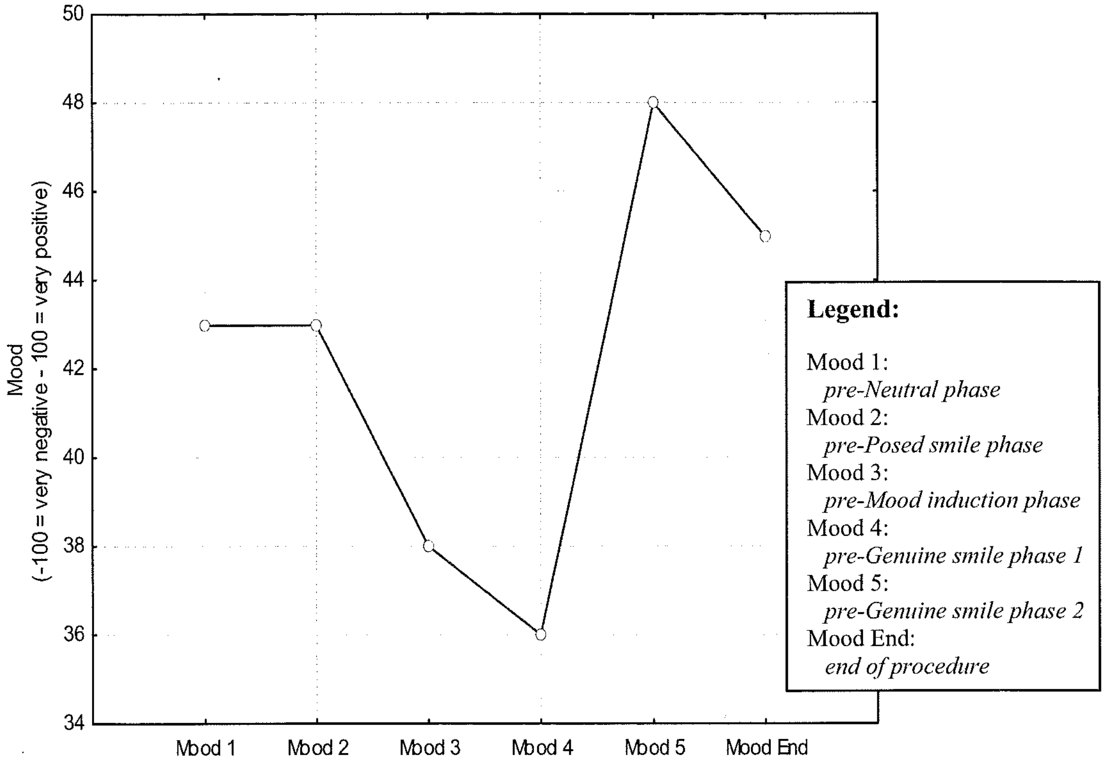

Figure E5: Participant F5

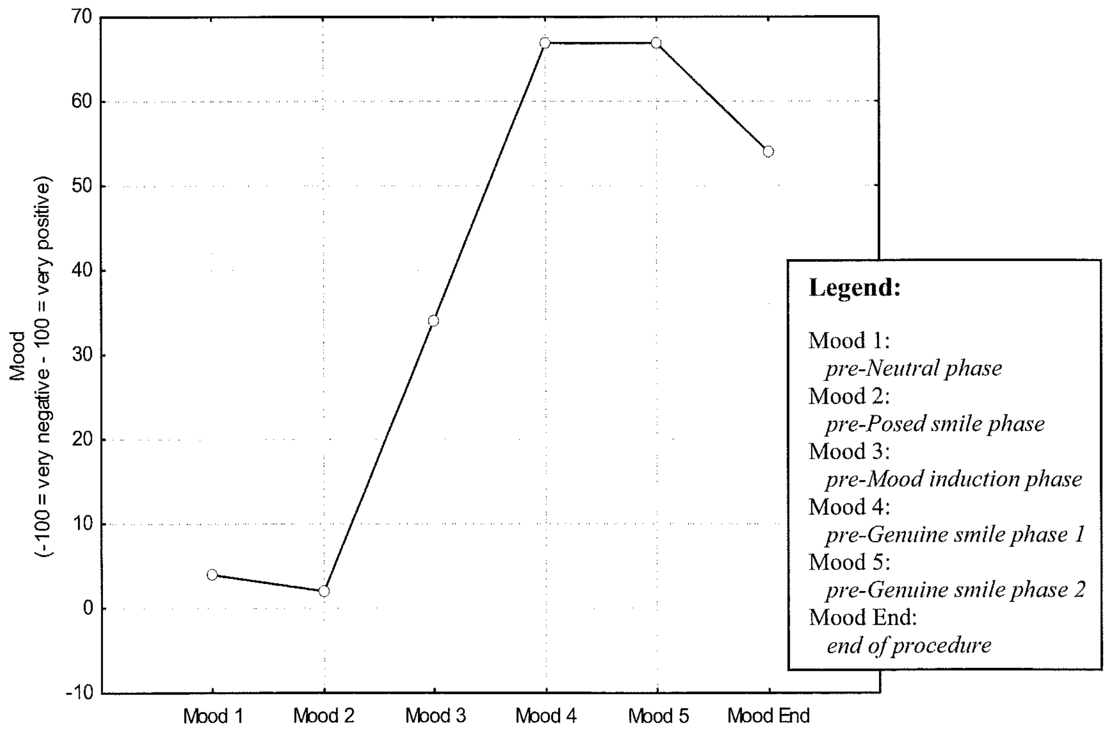

Figure E6: Participant F6

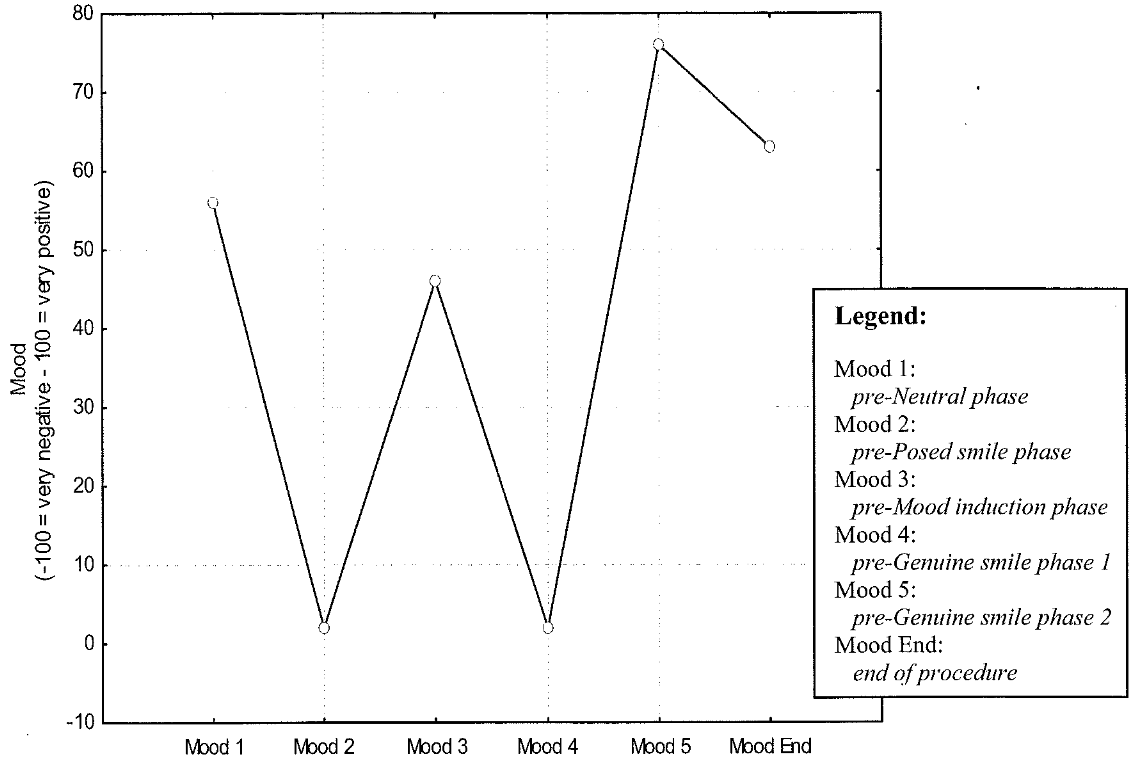

Figure E7: Participant F7

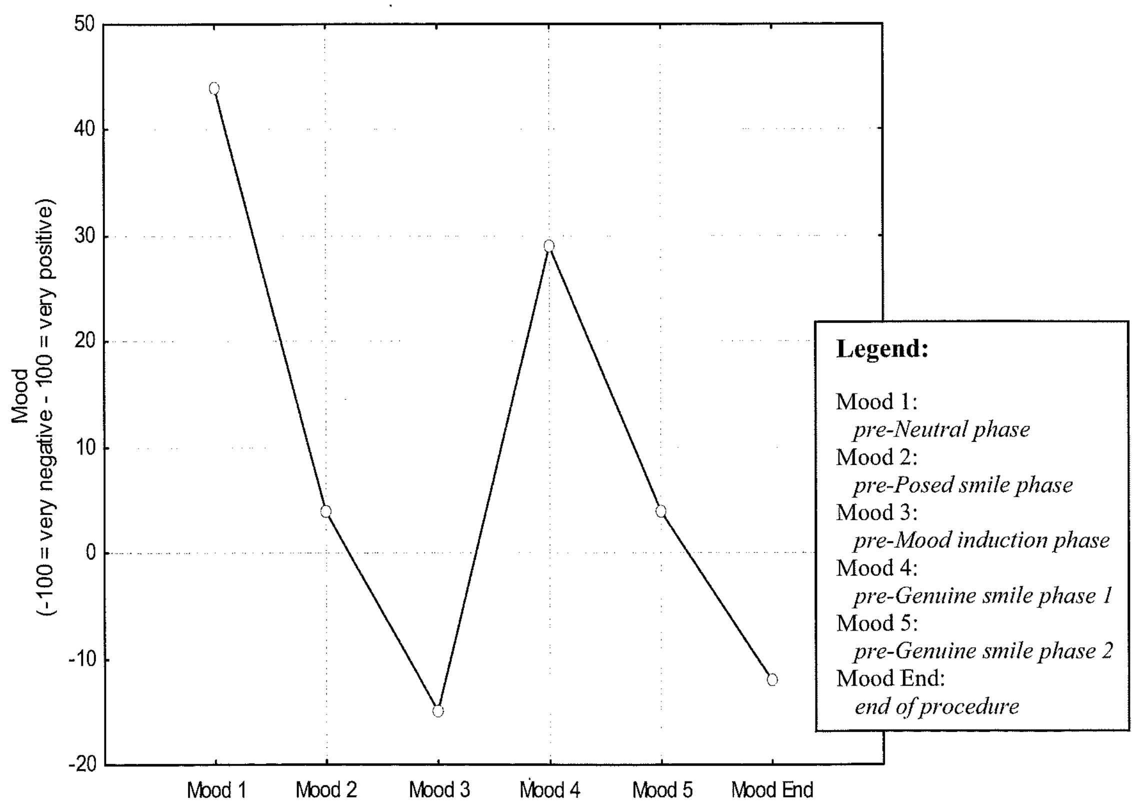

Figure E8: Participant F8

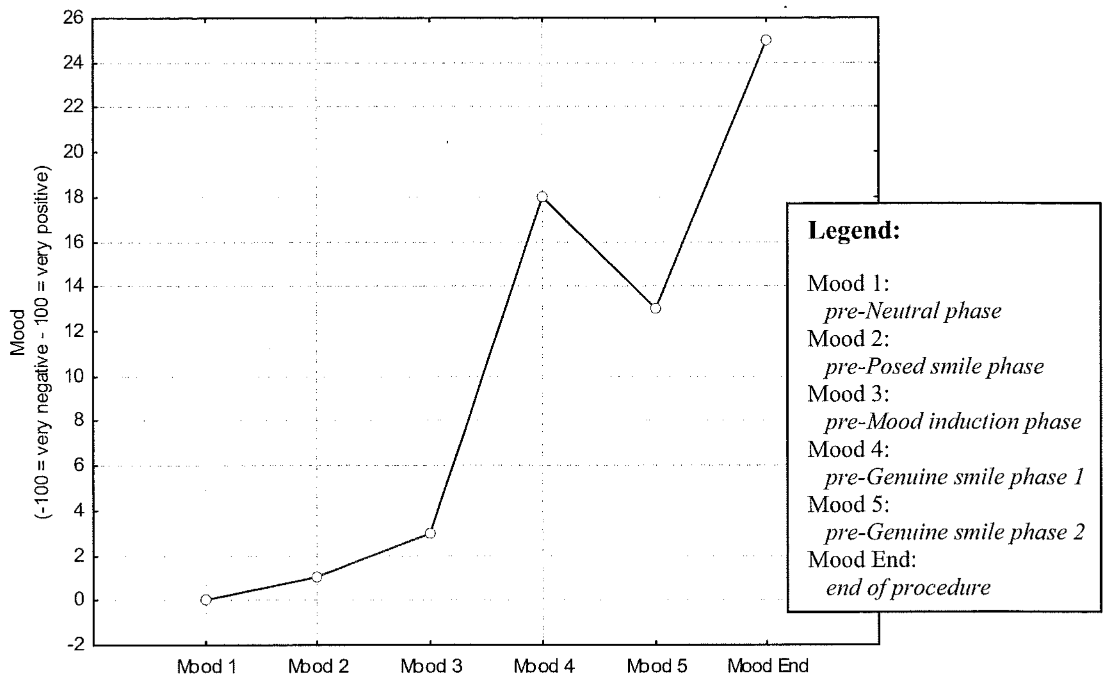

Figure E9: Participant M1

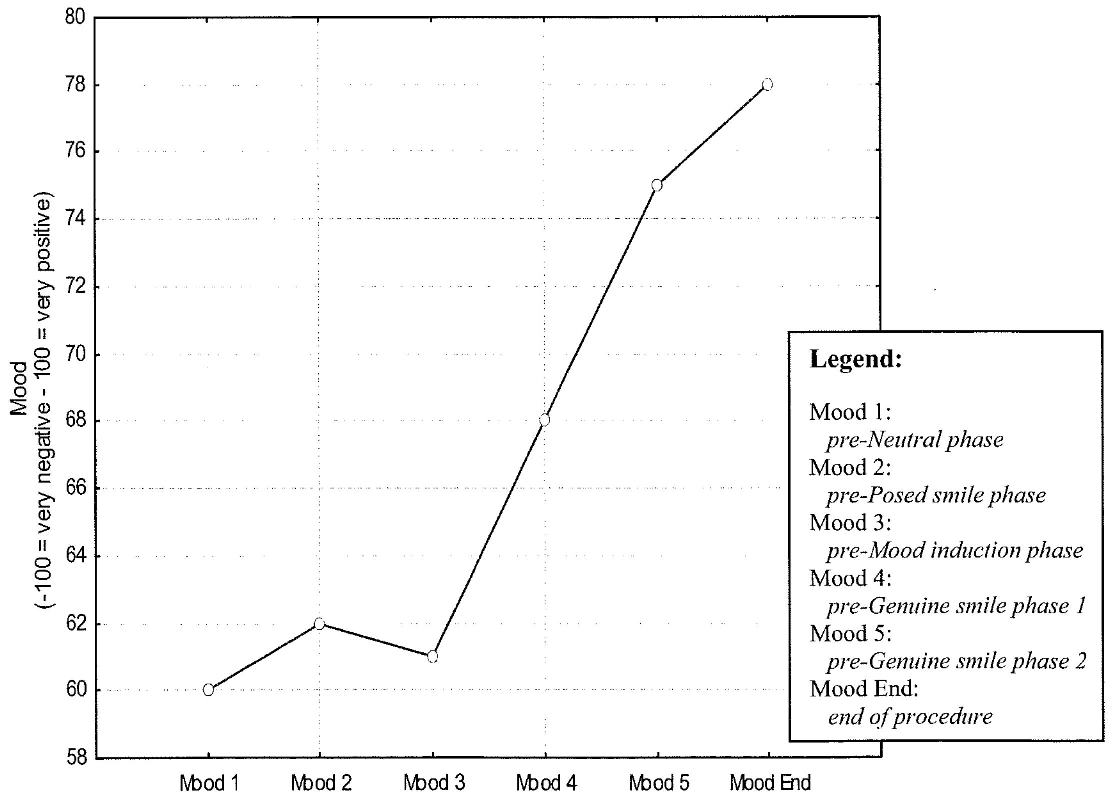

Figure E10: Participant M2

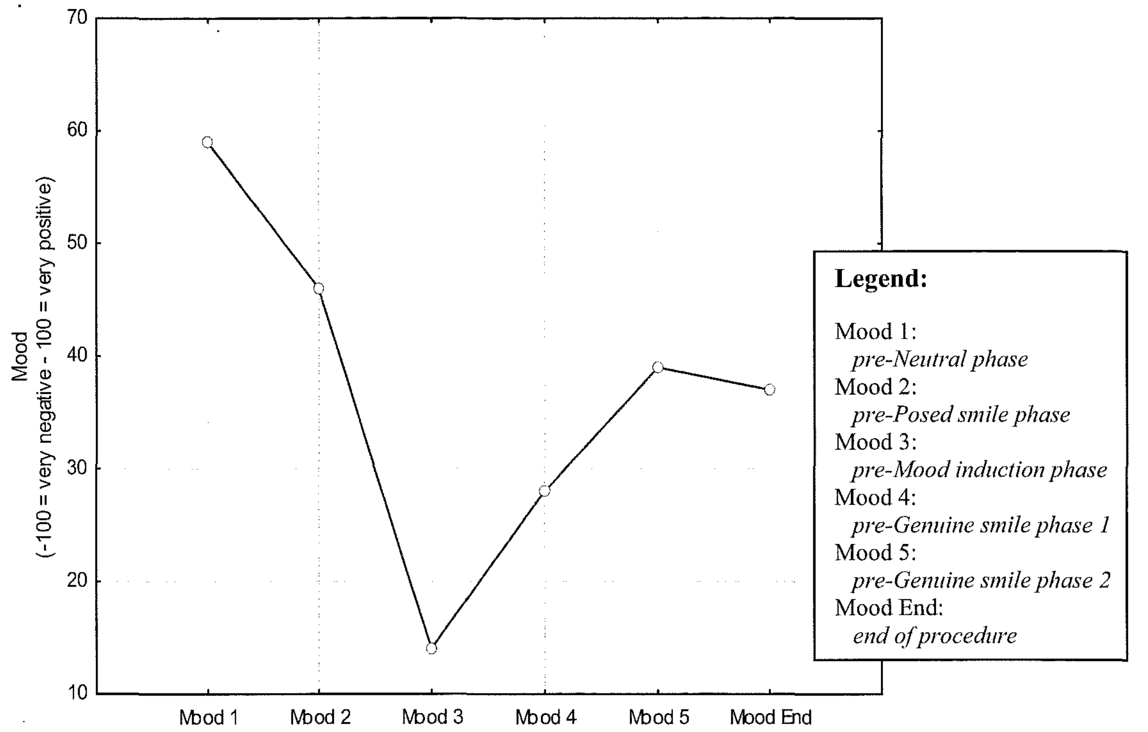

Figure E11: Participant M3

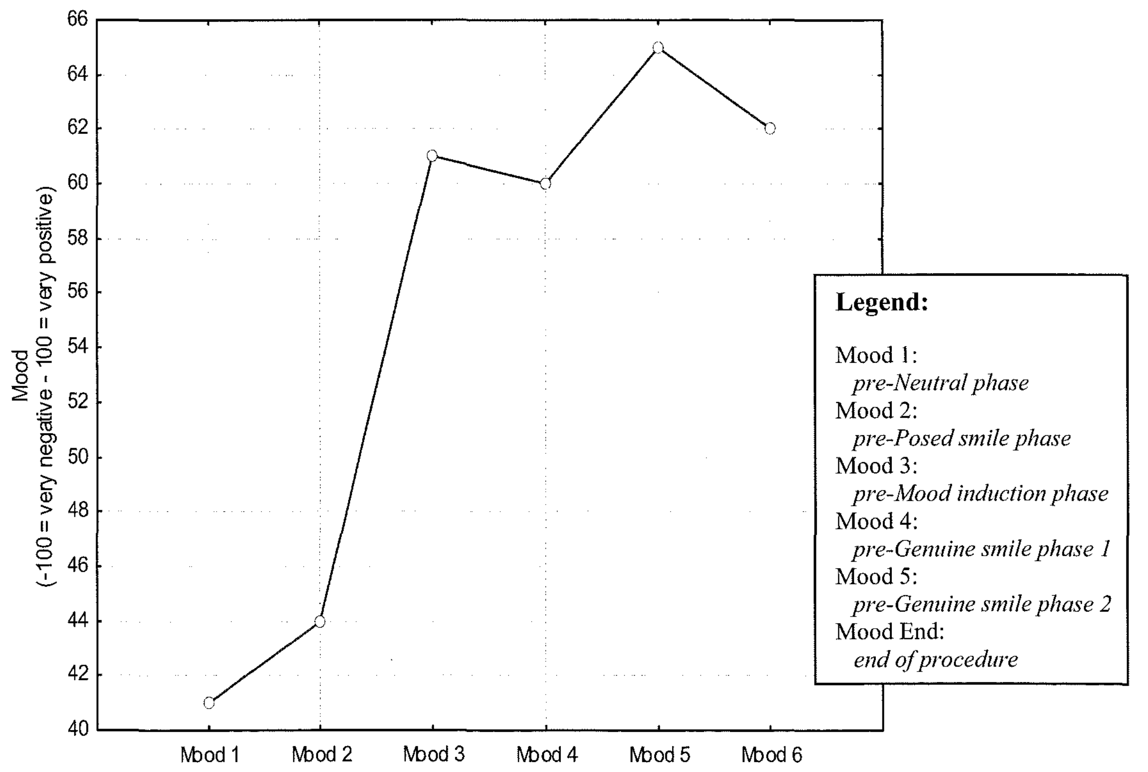

Figure E12: Participant M4

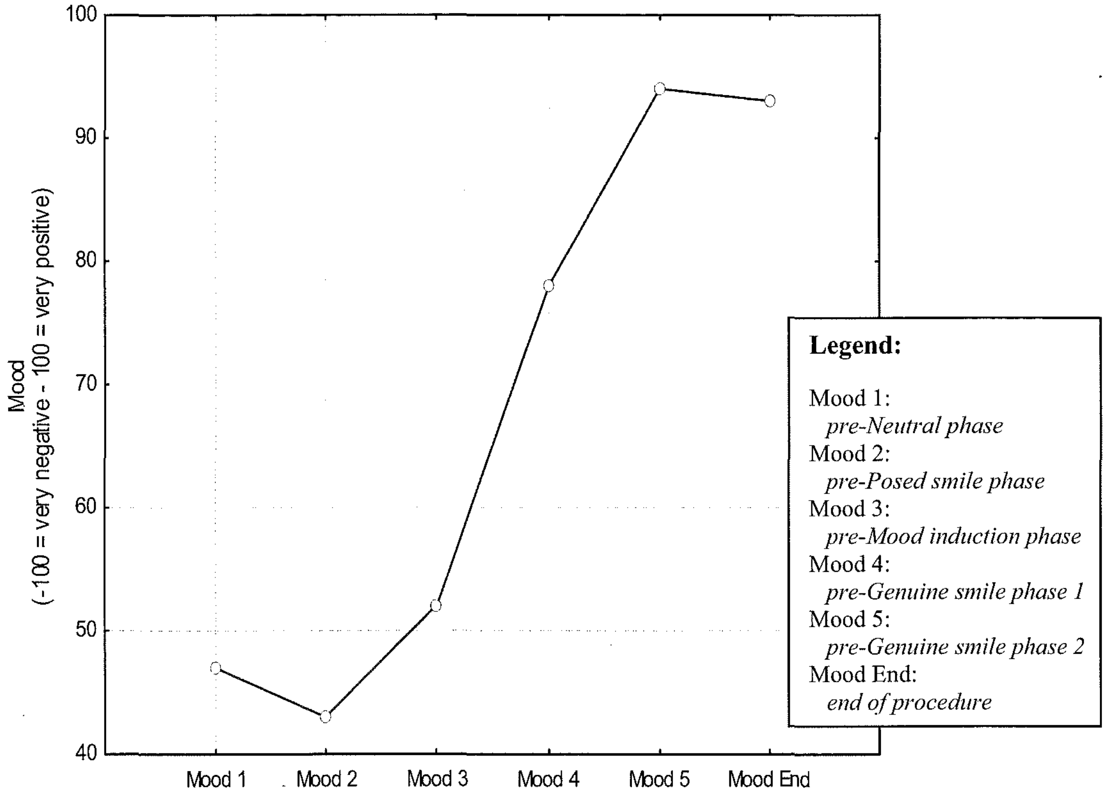

Figure E13: Participant M5

Appendix F: Information sheet for Experiments 1a and 1b.

Department of Psychology *University of Canterbury*

Forming Impressions From Faces: Information Sheet

You are invited to participate in the above-named research project. The aim of this project is to examine whether different types of facial expressions lead people to form different types of impressions. In particular, we are interested in the idea that our expression and experience of emotion do not have to be the same. Sometimes we can be experiencing an emotion but not express it, and other times we can express an emotion without having to experience it. For instance if you encounter a person who you do not particularly like, often you will hide your displeasure and perhaps smile politely.

Your participation will involve completion of a computer administered face judgment task. In total, participation will take less than 10 minutes. You are free to withdraw from the project at any time, including withdrawal of any information you have provided.

The results of this project may be published, but you can be assured of the complete confidentiality of data gathered in this investigation. To ensure anonymity and confidentiality, you are not asked to provide any identifying information at any stage of the project.

By completing the study, however, it will be understood that you have consented to participate in the project, and that you consent to the publication of the results of the project with the understanding that anonymity will be preserved.

The project is being carried out by Lynden Miles, under the supervision of Dr Lucy Johnston. Lynden can be contacted on 364 2987, x7704 or lkm21@student.canterbury.ac.nz, to discuss any questions you may have regrading participation in this project.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee.

Appendix G: Consent form for Experiments 1a and 1b

Department of Psychology *University of Canterbury*

Forming Impressions From Faces: Consent Form

I, the undersigned, have read and understood the information sheet for the study 'Forming Impressions from Faces'. I consent to participate and understand that the results of this study may be published, but my anonymity will be preserved.

Signed: ______________________ Date: / / ____________

Appendix H: Formulae for calculation of non-parametric indices of sensitivity (A') and response bias (B'').

Sensitivity (A'):

- For $H \geq FA$: $A' = 0.5 + [(H - FA)(1 + H - FA)] / [4H(1\text{-}FA)]$
- For $FA > H$: $A' = 0.5 - [(FA - H)(1 + FA - H)] / [4FA(1\text{-}H)]$

Response bias (B''):

- For $H \geq FA$: $B'' = [H(1 - H) - FA(1 - FA)] / [(H(1 - H) + FA(1 - FA)]$
- For $FA > H$: $B'' = [FA(1 - FA) - H(1 - H)] / [(FA(1 - FA) + H(1 - H)]$

Where H = hit rate, and FA = false alarm rate.

Appendix I: List of target words used for Experiment 2

Positive words	*Mean valence rating (s.d.)*
Approachable	7.54 (1.56)
Authentic	7.85 (1.34)
Decent	7.90 (1.64)
Friendly	8.43 (1.08)
Fun	8.37 (1.11)
Genuine	7.99 (1.23)
Honest	7.70 (1.43)
Joy	8.60 (0.71)
Kiss	8.26 (1.54)
Love	8.72 (0.70)
Respectable	7.64 (1.29)
Sincere	7.94 (1.45)
Trustworthy	7.68 (2.61)
Truthful	7.80 (1.29)
Valid	7.76 (1.45)

Negative words	*Mean valence rating (s.d.)*
Bogus	2.45 (1.56)
Corrupt	2.32 (1.23)
Deceitful	2.50 (1.63)
Depressed	1.83 (1.42)
Devious	2.21 (1.99)
Dishonest	1.93 (1.61)
Failure	1.70 (1.07)
False	2.27 (1.40)
Fraud	2.47 (1.66)
Hate	2.12 (1.72)
Liar	2.31 (1.78)
Repulsive	2.01 (1.32)
Sad	1.61 (0.95)
Terrible	1.93 (1.44)
Unreliable	2.34 (1.67)

Appendix J: Information sheet for Experiment 2

Department of Psychology *University of Canterbury*

Mood and Word Recognition: Information Sheet

You are invited to participate in the above-named research project. The aim of this project is to examine the effects of mood on a word judgement task.

Your participation will involve completion of a very short questionnaire, followed by a computer administered word recognition task. In total, participation will take less than 20 minutes. In return you will be given a 'scratch and win' lottery ticket. You are free to withdraw from the project at any time, including withdrawal of any information you have provided.

The results of this project may be published, but you can be assured of the complete confidentiality of data gathered in this investigation. To ensure anonymity and confidentiality, you are not asked to provide any identifying information at any stage of the project.

By completing the study, however, it will be understood that you have consented to participate in the project, and that you consent to the publication of the results of the project with the understanding that anonymity will be preserved.

The project is being carried out by Lynden Miles, under the supervision of Dr Lucy Johnston. Lynden can be contacted on 364 2987, x7704 or lkm21@student.canterbury.ac.nz, to discuss any questions you may have regrading participation in this project.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee.

Appendix K: Consent form for Experiment 2.

Department of Psychology *University of Canterbury*

Mood and Word Recognition: Consent Form

I, the undersigned, have read and understood the information sheet for the study 'Mood and word Recognition'. I consent to participate and understand that the results of this study may be published, but my anonymity will be preserved.

Signed: ______________________ Date: /   /

Appendix L: Summary of data cleaning by participant for Experiment 2.

Table L1: Data removed (errors and outliers) by participant

Participant	**Trials**	**# correct**	**% errors**	**# outliers**	**% outliers**	**# remain**	**% remain**
1	300	276	8.0	7	2.5	269	89.7
2	300	290	3.3	4	1.4	286	95.3
3	300	295	1.7	5	1.7	290	96.7
4	300	289	3.7	4	1.4	285	95.0
5	300	270	10.0	7	2.6	263	87.7
6	300	281	6.3	5	1.8	276	92.0
7	300	247	17.7	4	1.6	243	81.0
8	300	281	6.3	3	1.1	278	92.7
9	300	285	5.0	4	1.4	281	93.7
10	300	294	2.0	4	1.4	290	96.7
11	300	293	2.3	5	1.7	288	96.0
12	300	274	8.7	4	1.5	270	90.0
13	300	294	2.0	3	1.0	291	97.0
14	300	286	4.7	3	1.0	283	94.3

Appendix M: General form and conditions for the Prisoners' Dilemma (adapted from Kuhlman and Marshello, 1975)

	Person B	
Person A	Cooperation	Defection
Cooperation	R / R	S / T
Defection	T / S	P / P

The first value in each cell is person A's payoff, while the second value is person B's payoff. Following Rapaport and Chammah (1965), R indicates reward for mutual cooperation, S indicates sucker's payoff, T is temptation to defect, and P is punishment for mutual defection.

A prisoners' dilemma game obtains when the following inequalities are satisfied:

1. $T > R > P > S$
2. $2R > T + S > 2P$

In the present research $P = 4$, $R = 6$, $S = 3$, and $T = 7$, which conform to the general form and conditions of the Prisoners' Dilemma:

1. $7 > 6 > 4 > 3$
2. $12 > 10 > 8$

Appendix N: Social Value Orientation task, Experiment 3.

Department of Psychology *University of Canterbury*

Social Psychology and Cyberspace:
Communicating Across the Internet

INTERACTION TASK 1: OVERVIEW

In this task you will be randomly paired with another participant, whom we will simply refer to as the "Other". For this task, the identity of the other participant will remain anonymous – you won't find out who they are, and they won't find out who you are. Both you and the other participant will be making choices by circling one of the letters: A, B or C. Your choices will produce points for both you and the other participant. Likewise, the other person's choice will produce points for them and for you. Every point has value: the more points you receive (from both yourself and the other participant) the more you will be paid for completing this part if the study, and likewise the more points the other participant receives the more they will be paid.

Here is an example of how this task works:

	A	**B**	**C**
You get	**500**	**500**	**550**
Other gets	**100**	**500**	**300**

In this example if you chose A you would receive 500 points and the other person would receive 100 points; if you chose B you would receive 500 points and the other person would receive 500 points; if you chose C you would receive 550 points and the other person would receive 300 points. So, you see that your choice influences both the number of points you receive and the number of points the other person receives.

Before you begin making choices, please keep in mind that there are no right or wrong answers – choose the option that you, for whatever reason, prefer the most. Also, remember that the points have value: the more you accumulate the more you will be paid for completing this part of the study. Likewise, from the other's point of view, the more points they accumulate the more they will be paid.

Ask the experimenter now if you have any questions.

For each of the nine choice situations below, circle A, B or C depending on the option you prefer the most.

		A	B	C
(1)	You get	4.80	5.40	4.80
	Other gets	.80	2.80	4.80

		A	B	C
(2)	You get	5.60	5.00	5.00
	Other gets	3.00	5.00	1.00

		A	B	C
(3)	You get	5.20	5.20	5.80
	Other gets	5.20	1.20	3.20

		A	B	C
(4)	You get	5.00	5.60	4.90
	Other gets	1.00	3.00	4.90

		A	B	C
(5)	You get	5.60	5.00	4.90
	Other gets	3.00	5.00	.90

		A	B	C
(6)	You get	5.00	5.00	5.70
	Other gets	5.00	1.00	3.00

		A	B	C
(7)	You get	5.10	5.60	5.10
	Other gets	5.10	3.00	1.10

		A	B	C
(8)	You get	5.50	5.00	5.00
	Other gets	3.00	1.00	5.00

		A	B	C
(9)	You get	4.80	4.90	5.40
	Other gets	1.00	4.90	3.00

Appendix O: Resource Dilemma task, Experiment 3

Department of Psychology *University of Canterbury*

Social Psychology and Cyberspace:
Communicating Across the Internet

INTERACTION TASK 2: OVERVIEW

In this task, you will be interacting with another participant located in a separate testing room in the Psychology Department. Interaction will occur via a network link using the university's intranet. To ensure this technology runs smoothly it is important that you follow all instructions for this task carefully.

For this task, you take on the role of the captain of a fishing boat licensed to catch fish from a small lake. The total number of fish you are able to harvest will determine your success as a fishing boat captain and ultimately how much payment you receive for this task. The lake starts out with a total stock of **100** fish and only you and one other boat are permitted to take fish from this lake. Every season you are each able to catch **15** fish, but the total number of fish in the lake must never fall below **70** or you will have your fishing boat and all profits confiscated. Therefore, at the end of each season you have the opportunity to return some, or all, of your catch to the lake. The captain of the other boat also has this opportunity although you have no means of communication with this boat therefore can never know how many fish they caught/returned. Whether you return any fish to the lake or not influences the number of fish available in the subsequent season according to the accompanying table. For example, if you return 2 fish to the lake, in the next season there will be 20 fewer fish available; while if you return 13 fish to the lake, in the next season there will be 35 more fish available. Remember that these numbers only apply to the fish you catch – not the fish caught by the other fishing boat.

You will play several seasons of this 'fishing task'. For each season, you are simply required to indicate how many fish, out of your catch of 15, you wish to return to the lake. If the number of fish in the lake at the start of any season ever drops below 70 the game is over. Keep in mind there are no right or wrong answers, but remember that the more fish you can harvest, the more successful you will be as a fishing boat captain and the more money you will be paid for completing this task.

Number of fish returned	Effect on number of fish in lake
0	-30
1	-25
2	-20
3	-15
4	-10
5	-5
6	0
7	+5
8	+10
9	+15
10	+20
11	+25
12	+30
13	+35
14	+40
15	+45

Appendix P: Prisoners' Dilemma task, Experiment 3.

Department of Psychology *University of Canterbury*

Social Psychology and Cyberspace:
Communicating Across the Internet

INTERACTION TASK 3: OVERVIEW

In this task you will be interacting with other participants located in separate testing rooms in the Psychology Department. Interaction will occur via video links using the university computer network. To ensure this technology runs smoothly it is important that you follow all instructions for this task carefully.

Each interaction will last for approximately 1 minute. During this time, you will have an opportunity to see your partner, and they will have an opportunity to see you. You will then both be faced with a simple decision; choose one of two options: 'A' or 'B'. Your choice, in conjunction with the choice of your partner, will determine how many points you receive for that trial. The more points you accumulate, the more money you will be paid for completing this task. Points will be allocated according to the table below:

	Partner	
You	***A***	***B***
A	6 (*6*)	3 (*7*)
B	7 (*3*)	4 (*4*)

The first number represents how many points **you** will receive and the number in brackets represents how many points your partner will receive.

To many people the optimal strategy for this task seems obvious, and their reasoning may appear flawless. Either your partner is going to choose 'A' or to 'B'. Logically those are the only two possibilities. But either way, you would do better, that is get more points, choosing 'B' rather than choosing 'A'. Hence, it may seem that if you are 'rational', you will choose 'B'. However, the same reasoning would seem to apply to your partner with equal validity. That is, if they are 'rational', they will also choose 'B'. In short, if you are both 'rational', you will both choose 'B' and receive 4 points – substantially less than the maximum on offer. Remember that the more points you accumulate, the more you will be paid for completing this task.

Appendix Q: Information sheet, Experiment 3.

Department of Psychology *University of Canterbury*

Social Psychology and Cyberspace: Communicating Across the Internet

Participant Information

You are invited to participate in the above-named research project. The aim of this project is to examine aspects of the ways people communicate when using the internet.

Your participation will involve completing two short questionnaires, followed by two interaction tasks using computers, and a short recognition task. This procedure will take no longer than one hour and, depending on your performance during these tasks, you will receive a voucher worth between $5 and $25 in return. You are free to withdraw from the project at any time, including withdrawal of any information you have provided.

The results of this project may be published, but you can be assured of the complete confidentiality of data gathered in this investigation. To ensure anonymity and confidentiality, you are not asked to provide any identifying information at any stage of the project.

By completing the study, however, it will be understood that you have consented to participate in the project, and that you consent to the publication of the results of the project with the understanding that anonymity will be preserved.

The project is being carried out by Lynden Miles, under the supervision of Dr Lucy Johnston. Lynden can be contacted on 364 2987, x7704 or lkm21@student.canterbury.ac.nz, to discuss any questions you may have regarding participation in this project.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee.

Appendix R: Consent form 1, Experiment 3

Department of Psychology *University of Canterbury*

Social Psychology and Cyberspace: Consent Form I

I, the undersigned, have read and understood the information sheet for the study 'Social Psychology and Cyberspace: Communication and the Internet'. I consent to participate and understand that the results of this study may be published, but my anonymity will be preserved.

I understand also that I may at any time withdraw from the project, including withdrawal of any information I have provided.

Name: ______________________________

Signed: ______________________________ Date: /   /

Appendix S: Debriefing questionnaire, Experiment 3

Department of Psychology *University of Canterbury*

Social Psychology and Cyberspace:
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Please answer the following questions after you have completed all interaction tasks:

1. What strategies did you use to decide how to interact with each partner

____

____

____

2. What do you think the purpose of the study was?

____

____

____

3. Did any part of the study seem strange or suspicious to you? If so please describe.

____

____

____

- Thankyou for your participation -

Appendix T: Debriefing sheet, Experiment 3

Department of Psychology *University of Canterbury*

Social Psychology in Cyberspace: Debriefing Sheet

Thank you for participating in this project. In the information given to you prior to your participation, you were told that part of this study would involve interacting with other people using web cameras across the internet. In fact, this was not the case. The other 'participants' you saw were in fact videos we had prepared for the purposes of this study. Furthermore, the payment you receive for participating in this study was not determined by your success in the interaction task – all participants received a $10 voucher for completing this stage of the study. The actual purpose of the study was to gauge whether the facial expressions exhibited by the people in the videos influenced the way you behaved during the interaction task. Specifically, some of the facial expressions were genuine smiles and some were posed smiles. It is important to be sensitive to the difference between these expressions as a genuine smile is an honest signal of happiness, while, by comparison, a posed smile is an attempt to simulate a genuine expression without experiencing the underlying emotional state. In this sense, a posed smile can be considered a form interpersonal deception. We predicted that you would cooperate with the individuals exhibiting genuine smiles to a greater degree than with those exhibiting posed smiles.

It was necessary to deceive you in this manner for two reasons. Firstly, a genuine smile is a spontaneous expression of enjoyment that cannot be generated on demand. In other words, posing a genuine smile is not possible. Therefore we used videos of people exhibiting this expression in order to have control over what facial expressions you perceived during each interaction. Secondly, it was important to keep you blind to the specific hypothesis of the study, so as not to influence your responses.

The results from this study will be available in approximately two months time. If you are interested in these results when they become available, or have any questions regarding this study, please inform the experimenter.

Thank you.

Appendix U: Consent form 2, Experiment 3.

Department of Psychology *University of Canterbury*

Social Psychology and Cyberspace: Consent Form II

I, the undersigned, have read and understood the debriefing sheet for the study 'Social Psychology and Cyberspace: Communication and the Internet'. I give permission for the data that I have provided to be retained for the purposes of the research and understand that the results of this study may be published, but my anonymity will be preserved.

I understand also that I may at any time withdraw from the project, including withdrawal of any information I have provided.

Name: ______________________________

Signed: ______________________________ Date: /   / ________

Payment received: